



Early Journal Content on JSTOR, Free to Anyone in the World

This article is one of nearly 500,000 scholarly works digitized and made freely available to everyone in the world by JSTOR.

Known as the Early Journal Content, this set of works include research articles, news, letters, and other writings published in more than 200 of the oldest leading academic journals. The works date from the mid-seventeenth to the early twentieth centuries.

We encourage people to read and share the Early Journal Content openly and to tell others that this resource exists. People may post this content online or redistribute in any way for non-commercial purposes.

Read more about Early Journal Content at <http://about.jstor.org/participate-jstor/individuals/early-journal-content>.

JSTOR is a digital library of academic journals, books, and primary source objects. JSTOR helps people discover, use, and build upon a wide range of content through a powerful research and teaching platform, and preserves this content for future generations. JSTOR is part of ITHAKA, a not-for-profit organization that also includes Ithaka S+R and Portico. For more information about JSTOR, please contact support@jstor.org.

**RACIAL VARIATION IN PLANTS AND ANIMALS, WITH SPECIAL REFERENCE
TO THE VIOLETS OF PHILADELPHIA AND VICINITY.**

BY WITMER STONE.

Having for a number of years been interested in racial variation among terrestrial vertebrates and its relation to environment and climatic conditions, I was recently led to make some investigations along the same lines among our phanerogamic plants, in some genera of which, notably *Cratægus*, *Panicum*, *Viola*, etc., species and subspecies have of late years been described at a rate quite equal to that which has prevailed for some time past among the birds and mammals.

The genus *Viola* was selected for study because I have long been familiar with the more common species found in the vicinity of Philadelphia, and because an abundance of material is easily accessible in this neighborhood.

While my studies have thrown little light upon the relation of variations to conditions of environment, they have enabled me to present a pretty complete account of the variations exhibited by our local violets which may prove of assistance to those who investigate this interesting genus.

Any one at all in touch with the progress of systematic zoology and botany must be aware of the enormous number of new species and subspecies that have been named and described during the last decade. By some, especially those who have not gone very deeply into systematic work, this tendency has been severely criticised as unwarranted multiplication of names in the interest of the describer, which tends to render specific identification more difficult on the part of the general student. To those who have given the matter serious consideration, however, it must be evident that slowly but surely our conception of a species has been changing, and that the recognition of a very large number of new forms in systematic work is an obvious necessity on evolutionary and philogenetic grounds.

The enormous collections that have been gathered together in recent years, especially in the United States, covering thoroughly, as they do, large contiguous areas instead of isolated spots as heretofore, show us that instead of sharply defined widespread species we have, in

many cases, a number of slightly differentiated local forms, sometimes susceptible of being banded together as races of one specific group or sometimes so intricately interrelated as to involve several previously well-established "species," and to render any arrangement in groups a matter of the closest study and more or less arbitrary decision.

No one description will accurately cover all of these related races, and as the specific descriptions of older writers are often based entirely upon one race or form, there is obviously no course but to recognize the others on an equal basis.

Whether or not our present system of nomenclature will prove inadequate for the purpose remains to be seen, but under any circumstances the recognition of these forms which nature has differentiated in a greater or lesser degree will be inevitable, as it is becoming obvious that they, instead of the clumsy specific aggregate, are the fundamental units of systematic work.

The existence of these "variants" among vertebrates was first clearly accepted in the *Check List of North American Birds*, issued by the American Ornithologists' Union in 1886, and a system of trinomials was adopted by which they could be independently designated and at the same time their relation to their specific aggregate denoted. This plan has been largely followed in vertebrate zoology since this time, but as material and knowledge has increased the difficulty of grouping forms in specific aggregates, in such a manner as not to do violence to the proper function of a name on the one hand and to a fact of evolution on the other, has so increased that by some writers trinomials have been all but abandoned, and binomials employed to designate every form, no matter how slightly differentiated. In botany, where the trinomial system has never been so widely adopted as in vertebrates, almost all the recently named forms are designated as species.

As I have elsewhere stated,¹ I am convinced that the use of trinomials is still our best method for denoting these races, though not on exactly the basis originally proposed in the American Ornithologists' Union Code of Nomenclature.

The results of my study of variation in the genus *Viola* I have considered under three headings: Racial Variation, as exhibited in plants; Variation in the Genus *Viola*; and a Synopsis of the Violets of Philadelphia and vicinity. For the sake of comparison I have preceded these with a brief *résumé* of racial variation among terrestrial vertebrates.

¹ Condor, 1903, p. 43.

RACIAL VARIATION AMONG TERRESTRIAL VERTEBRATES.

Variation in animals may be of several different types: (1) sexual, (2) age and seasonal, (3) dimorphic, (4) individual, albinistic, etc., and (5) specific or racial.

We have a terse nomenclature by which differences of sex, age, etc., may be denoted, and sometimes, as in birds, quite a complicated terminology by which every plumage is designated (cf. Dwight, *Auk*, 1902, p. 248), but our binomial and trinomial nomenclature is used only for specific or other racial variations.

Among terrestrial vertebrates racial variation corresponds closely to geographic environment, and in many groups it is very easy to recognize the effect of the environment of several different life areas in producing recognizably distinct races from the same type.

In birds and mammals this correspondence is most marked, though among them we find some genera much more plastic than others; the song sparrows (*Melospiza*), for instance, breaking up into a very large number of forms, while the robins (*Merula*) are remarkably constant over large areas. In birds and mammals the individual variation in size, after making due allowance for age and sex, is exceedingly slight, and the same may be said of color, provided the additional allowance for season is made, so that very slight differences in measurements or in shades of color, which might appear trivial, are really constant and perfectly reliable as indications of the differentiation of a distinct form.

Among reptiles individual variation is very much greater, and geographic races cannot be so clearly designated as in the classes just considered. Measurements are of little significance, except in the relation which one dimension may hold to another; color and scale formulæ are also subject to great variation. Some species, however, vary much more than others, and in slightly differentiated forms with a high percentage of individual variation extremes may overlap in certain respects, or an occasional individual may revert to an ancestral type in some character or other, without affecting the fact that a race has been differentiated. Such individuals are referable to the same category as geographic intergrades in the usually narrow belt, where life-areas which have given rise to two forms merge one into the other.

In the Batrachia individual variation is further complicated by the metamorphosis which is often responsible for the persistence of certain early (larval) characters in the adult, and that many species in this class have been based upon this and other individual variations I have little doubt.

In the higher terrestrial vertebrates, as already pointed out, the ranges of several closely related forms are coextensive with the limits of the several life-areas to the peculiar environmental conditions of which they owe their origin. Consequently we never find two geographic races or subspecies of the same form occurring together, except during times of migration. Among reptiles, however, we do find variants of the same form which have been generally rated as subspecies occurring in the same life-area. We perhaps need more material and more exact data regarding habitat, etc., before the proper status of such forms is established. They may be color types or dimorphic forms produced indiscriminately throughout the range of the species; or are, perhaps, due to local, soil or other conditions prevailing in different areas within the range of the species. The fact that such forms occur together and intergrade, however, seems abundantly proven.

The above *résumé* is presented, showing the conditions which exist among terrestrial vertebrates with regard to racial variation, in order that they may be compared with the conditions that prevail among plants.

RACIAL VARIATION AMONG PLANTS.

As is well known, the trees and shrubs, as well as other plants in a less degree, conform with more or less exactness to the same general laws of geographic distribution that pertain to animals; and the ranges of many species are limited by the life-zones that have been established originally from a study of birds and mammals.

When, however, a genus is represented by different forms in several life-zones, they are usually very distinct species and not closely related variants which have obviously been differentiated from a common parent type by prevailing environmental conditions in the several life-areas in question, such as is so frequently seen among vertebrates.

At the same time an abundance of closely related variants do exist among plants, differentiated to the same varying extent as in the geographic races of birds and mammals, but all occurring in the same life-zone or area, and often side by side. They are, moreover, quite constant in their racial characters, and certainly not cases of individual variation.

Obviously some other agency must be responsible for this differentiation, and it is in many cases no doubt to be found in the varying soil conditions, and in other local peculiarities not sufficiently potent to affect higher animal life. Owing to the fixed nature of plant life,

such conditions are likely to have a very marked effect in producing local forms from widely distributed species, while, on the other hand, a freely moving animal is either not so easily affected or simply avoids localities within its range where soil conditions, etc., are uncongenial. Thus the pine-barren region of southern New Jersey, where soil conditions differ totally from the lower Delaware valley, though in the same life-zone, presents a most distinctive flora, but not a single "subspecies" of bird or mammal has been differentiated from those found in the latter area. Such species as are not averse to the conditions there presented occur unchanged, while others simply avoid the region and are conspicuous by their absence. Some very local races of mammals have been differentiated, it is true, in the Dismal Swamp of Virginia and other similar spots, but the effect of purely local conditions upon plant life is vastly greater than upon animals.

My studies have been entirely too limited to warrant any attempt to account for the origin of these local plant races, even in the genus to which I have devoted especial attention, but the point that I would particularly emphasize is that we have in these forms, which grow often side by side, just as clearly differentiated races as the geographic subspecies of vertebrates, and that they can be designated by trinomials to better advantage than by the binomial method now generally in vogue, even though the grouping be admittedly arbitrary in some instances (cf. *Condor*, 1903, p. 43). The careless use of the trinomial or varietal name in botany for all sorts of variation, purely individual, albinistic, etc., of course acts as a prejudice against applying it to well-established racial forms of this kind, but with the tremendous increase in species that we have recently witnessed in some genera the benefits of the trinomial system should be apparent. Unless we are thoroughly familiar with a genus, it is impossible to tell in a strictly binomial system which forms are clearly defined species and which are slightly differentiated races of a well-known type, while the use of trinomials indicates this at a glance.

Of course, in either animals or plants there must be some limit to the number of forms recognized, and nomenclature becomes absurd when applied to variants which can only be recognized by, perhaps, one or two specialists who have devoted years to the study of the group. This limit would seem to have been passed in the genus *Crataegus*. While there are admittedly a large number of species in eastern North America, the two hundred or more that have been proposed seem to more than cover the ground, especially since I have seen sets of specimens collected from six bushes and submitted to three leading

specialists on the genus returned as belonging to twice that number of species, due to the difference in their identifications.

VARIATION IN THE GENUS *VIOLA*.

My observations on the genus *Viola* as represented in the neighborhood of Philadelphia have covered a number of years, but during the past three seasons the study has been carried on systematically throughout the spring and summer. Typical colonies of the various forms have been constantly under observation, and large series of specimens have been preserved at definite periods which show as nearly as possible the changes undergone by each species. These specimens will be distributed in sets to several of the principal herbaria in the East, where they may perhaps be of assistance to others who are engaged in a study of this interesting genus.

The species of the genus *Viola* are divisible at once into two groups—the caulescent species, bearing both leaves and flowers upon a main stem, and the acaulescent, in which petioles and scapes spring from the root stalk. The species of the former group are much more easily defined, and show but little of the tendency to racial variation that is characteristic of the acaulescent group. We find three types of color in the flowers of the genus—blue, yellow and white—and all are represented in each of the above groups. In one caulescent species *V. rafinesquii* the flowers are somewhat parti-colored, as in the case of the pansies of cultivation, of which this is our native representative, forming a section well distinguished from the other species by additional characters. Among the caulescent species we also have one parti-colored race, *V. pedata*, which likewise is clearly separated from the others by structural peculiarities.

It is the blue-flowered acaulescent species that present by far the greatest racial and individual variation, and it is to them that I have given particular attention, and upon which the following statements are based, though all the species are considered in the review of our local violets which concludes the paper.

Leaf-form is decidedly the most striking character in violets, and one in which variation is to be seen to perfection. There is, first of all, variation due to age, the early leaves being usually different from those produced later in the season. The general shape of the early leaves is, moreover, very similar in a number of species which later on bear but little resemblance to one another—a fact which renders it exceedingly difficult to identify some of the descriptions of older writers based solely upon early flowering plants. In forms in which

the mature leaves are lobed or cut the early leaves are often quite or nearly entire, indicating the probable derivation of lobed-leaved species from an entire-leaved ancestor; and the tendency toward lobation seems to increase in all the later leaves.

Considering now the racial variations presented by the leaves, we find a tendency in two directions, starting from what I take to be the most primitive type—the cordate leaf of *V. papilionacea*, etc. In one direction we tend toward extreme lobing or leaf division, passing successively through *V. palmata dilatata*, *V. palmata*, *V. p. variabilis*, *V. p. angellæ*, *V. septemloba* and *V. brittoniana*, culminating with the aberrant *V. pedata*, in which the lobation is of a somewhat different type.

In the other direction, we pass through *V. fimbriatula* and its forms to the triangular-leaved *V. emarginata* and the narrow sagittate-leaved *V. sagittata*. This series has a tendency to toothed or notched bases to the leaves, and in very broad-leaved *V. emarginata* these teeth are exaggerated into lobes and a leaf-form is produced that comes very close to some of the *V. palmata* group near the other end of the series!

Individual variation is best shown in *V. p. dilatata* and *V. p. variabilis*. In these we are likely to find every variation, from a plain cordate leaf to one with from three to seven lobes, in the same colony of plants, and many of them actually on the same individual plant. Sometimes, too, we find leaves lobed on one side and not on the other. That these all belong to one race is certain, though the unlobed type has often been regarded as distinct under the name of *V. sororia*. That one style of leaf may prevail in one locality and another somewhere else seems quite likely, though all the colonies that I have examined exhibit a great variety of shapes.

So far as the correlation of the lobed-leaved species with peculiar soil conditions, there seems to be only contrary evidence. The *V. palmata* group are plants of the upland woods, *V. septemloba* is a moist-woodland violet and *V. brittoniana* occurs in open sandy ground, usually in moist spots, while *V. pedata* is a plant of dry sandy banks.

There does, however, seem to be a tendency toward narrow leaves in many wet-ground species, as seen in the linear divisions of *V. brittoniana* and the lanceolate leaves of *V. lanceolata* and *sagittata*.

In the pubescence of the leaves we have a pretty good specific character, though it seems to decrease somewhat on very old leaves, while very early leaves of *V. p. dilatata* are nearly glabrous, though the later ones are strongly pubescent. In *V. sagittata* some colonies have slightly pubescent leaves, while the typical plants are glabrous.

V. fimbriatula and its forms, the most pubescent species of the genus, are always found on exposed dry sandy or rocky banks, but *V. villosa* and *V. palmata*, also pubescent, are woodland species, and grow closely associated with *V. affinis*, which is glabrous. It may be said, however, that all species of moist, open ground are essentially glabrous, viz., *V. cucullata*, *V. crenulata* and typical *V. sagittata*.

The relative length of petioles and scapes is often quoted as a distinctive character, but such comparison should explicitly be made with either the first or second set of leaves, as the "flowering period" often covers the growth of the second leaves, so that early flowers are longer than the leaves while later ones are shorter. The length and character of the peduncle of the later cleistogamic flowers is an important specific character, as first pointed out by Prof. Greene. In some species it is long and erect, notably in *V. cucullata*; in others horizontal, and in others still very short and decurved and usually hypogæous. Except that in all wet-meadow species the cleistogenes are erect, we can make no correlation between their condition and the nature of their habitat, for in some forms that do not grow in wet spots, as *V. emarginata*, they are equally erect, while in other dry-ground species they vary much in length.

In floral characters violets seem to present a great amount of individual variation, but the difficulty of preserving the blossoms makes satisfactory comparisons on a large scale practically impossible. While a certain tint of blue or purple is characteristic of each form, there is also a good deal of individual variation. The marsh forms of the *V. cucullata* group are all pale blue, but the only colony of *V. emarginata* that I have studied in flower were almost as pale, though the species grows in dry, sandy situations. On the other hand, *V. sagittata*, from wet meadows, has as dark purple flowers as we find in *V. villosa* of the dry woodlands, so that in color also we find little correspondence with immediate environment.

The extent of pubescence on the petals is an important specific character, and varies from *V. septemloba*, where it is confined to the bases of the lateral petals, to *V. sagittata*, in which it usually spreads to some extent over all, though sometimes absent from the two uppermost.

As to relative time of flowering in the vicinity of Philadelphia, *V. fimbriatula*, *villosa* and *affinis* are the earliest, and are about over when *cucullata* and *dilatata* come into bloom, the difference being about two weeks; the other acaulescent blue species begin to blossom about midway between these two groups.

With regard to geographic distribution of the forms of violets, both caulescent and acaulescent, that I have identified in eastern Pennsylvania and southern New Jersey, six are characteristic boreal species, being found abundantly in the highest mountain districts, where the fauna is decidedly Canadian. Of these *V. canadensis*, *V. selkirkii*, *V. renifolia* are restricted to this region, but *V. rostrata*, *V. leconteana* and *V. roundifolia* extend much farther south in suitable locations, the last two reaching the southeastern corner of Pennsylvania. *V. muhlenbergii*, *V. cucullata* and *V. scabriuscula* also occur in the higher Alleghanies, but are equally as plentiful about Philadelphia.

Another group of species seems to be decidedly southern, and is limited to the low grounds of the lower Delaware and Susquehanna valleys or the coastal region of New Jersey, in the Carolinian faunal belt, viz., *V. brittoniana*, *V. lanceolata*, *V. septemloba* and *V. rafinesquii*.

The other forms, including the various forms of *V. palmata* and *fimbriatula*, seem to range indiscriminately over the intervening country, most of them spreading over the habitat of the last group as well.

THE VIOLETS OF PHILADELPHIA AND VICINITY.

The following synopsis is the result of several years' study, during which time a series of several thousand specimens has been collected and preserved and many observations upon living plants recorded. Undoubtedly further investigations will detect additional forms, and this list is not claimed to be complete but rather a basis for future work, in the belief that local studies of the genus will aid us in eventually gaining a better understanding of its species.

In the identification of the species I have to express my deep indebtedness to Prof. Edward L. Greene, the leading authority on the genus, who very kindly examined a series of my specimens and gave me his views upon their relationship, and also to Mr. Charles Louis Pollard, who has from time to time identified specimens for me. The types of Nuttall, Schweinitz and Muhlenberg in the herbarium of the Academy have thrown much light on the application of some of the older names.

We may consider the species in two main groups:

I. Acaulescent species, leaf petioles and flower scapes both arising from the root-stalk (p. 665).

II. Caulescent species, with a leafy stem upon which the flowers are produced (p. 686).

I. *Acaulescent Species.*

- I.—Plants producing stolons after the flowering season.
- a.—Flowers yellow, *V. rotundifolia*.
 - aa.—Flowers white.
 - b.—Leaves cordate at base, cleistogenes on horizontal peduncles.
 - c.—Petioles and scapes spotted with red, *V. leconteana*.
 - cc.—Petioles and scapes unspotted, . . . *V. blanda*.
 - bb.—Leaves decurrent on the petiole, cleistogenes erect.
 - c.—Leaves oval, *V. ovata*.
 - cc.—Leaves lanceolate, *V. lanceolata*.
- II.—Plants not stoloniferous, flowers blue.
- a.—Leaves more or less lobed or cut.
 - b.—Leaves and petioles pubescent.
 - c.—Lobes not deeply cut, only about half-way to the base, *V. palmata*.
 - cc.—Lobes deeply cut, nearly to the base, *V. p. dilatata, variabilis* and *angellæ*.
 - bb.—Leaves and petioles nearly or quite glabrous.
 - c.—Middle lobe undivided, no cleistogenes, *V. pedata* and subsp.
 - cc.—Middle lobe divided in three, cleistogenes present.
 - d.—Leaves large; lobes broad, much narrowed at base, *V. septemloba*.
 - dd.—Leaves medium, lobes nearly linear, *V. brittoniana*.
 - aa.—Leaves not lobed, never coarsely toothed or sagittate at the base.
 - b.—Leaves strongly hispid-pubescent above, glabrous below and on petiole, *V. villosa cordifolia*.
 - bb.—Leaves pubescent, on blade and petiole, cf. *V. palmata dilatata* and *V. fimbriatula aberrans*.
 - bbb.—Leaves glabrous or very nearly so.
 - c.—Cleistogenes on erect pedicels.
 - d.—Leaves cordate-ovate, plants medium or large, *V. cucullata* and subsp.
 - dd.—Leaves nearly triangular, plants small, *V. crenulata*.
 - cc.—Cleistogenes deflexed or horizontal.
 - d.—Leaves broadly cordate or reniform, apex not produced, flowers deep purple, *V. papilionacea*.
 - dd.—Leaves more triangular, apex attenuate, flowers pale lilac, *V. affinis*.
 - aaa.—Leaves sagittate, triangular or oval, usually with several coarse teeth at the base.
 - Leaves sagittate, usually glabrous, *V. sagittata*.
 - Leaves oval, or with truncate base, strongly pubescent, *V. fimbriatula*.
 - Leaves triangular, thick, fleshy, glabrous, . . . *V. emarginata*.

The yellow and white acaulescent violets in the vicinity of Philadelphia are referable to five described species, all of which are sharply separated with the exception of the *blanda-leconteana* group, which will upon further study undoubtedly resolve itself into several well-marked races. In fact, Prof. Greene tells me that the violet here described as *V. blanda* is certainly not typical of that species, but as it is not my intention here to propose any new names, I let it stand pending a more exhaustive study of this group.

The blue-flowered species, as already stated, constitute the most puzzling group of the genus. Apart from the aberrant *V. pedata*, the species fall naturally into three sections typified by *V. papilionacea* (Pls. XXXI–XXXII), *palmata* (Pl. XXXIII–XXXV) and *fimbriatula* (Pl. XXXVI–XXXVII), though it must be confessed that *V. villosa* is practically midway between the first and second groups, and that some forms of *V. emarginata* recall the *V. palmata* group. *V. selkirkii*, of the high Alleghanies, stands quite apart with more the habit of the white-flowered species.

1. *Viola rotundifolia* Michaux.

Viola rotundifolia Michaux, 1803, Flora Bor. Amer., II, p. 150.

Viola clandestina Pursh, 1814, Flora Am. Sept., I, p. 173.

Range.—Mountainous regions extending southward in suitable locations, reaching the valleys of Wissahickon and Crum creeks in Philadelphia and Delaware counties, where it occurs sparingly, and at one or two points in Montgomery county along the Schuylkill. In New Jersey, according to Dr. Britton's *Catalogue*, it reaches the lower part of Hunterdon and upper Monmouth counties. In its southernmost stations it usually grows under hemlocks, which are the prevalent trees in the true home of the species in the mountains.

Habitat.—Damp banks in deep shade.

Description.—Early flowering plant. Crum creek, Delaware county, Pa., April 13, 1902. No. 2,537, Herb. W. S. Flowers bright yellow, lateral and lower petals with fine dark brown lines, which in the former are confined to the lower edge, and immediately above them is a small patch of white hairs; sepals linear, oblong, obtuse; scape 60 mm. long, almost glabrous. Leaves involute, not yet expanded, and in some instances scarcely visible above the ground, pale green, 25 x 30 mm., crenate, minutely puberulent above, petiole 30 mm., slightly pubescent, or in very young leaves glabrous. Fruiting plant, Crum creek, May 30, 1901. No. 1,180, Herb. W. S. Scape 45 mm., capsule 8 mm., segments keeled. Leaves flat on the ground, ovate, the latest ones orbicular, 80 x 60 mm., crenate, light green above with minute scattered hairs,

pale and glabrous beneath, except on the basal part of the midrib which, with the petiole (60 mm.), is distinctly pubescent. These specimens bear "stolons" 100 mm. long, which I have not found rooting, but which bear several small lanceolate bracts and a leaf 25 x 35 mm., with several cleistogenes on very short pedicels. Still later specimens, August 4, have the leaves darker green and nearly or quite glabrous, as are the petioles; cleistogenes in fruit, nearly ripe.

2. *Viola blanda* Willd.

Viola blanda Willdenow, 1806, Hortus Berolien. Pl. XXIV.

Range.—Through southeastern Pennsylvania and southern New Jersey, west of the pine barrens; the records of its occurrence toward the mountains are in part confused with *V. leconteana*. Rather local, though not rare about Philadelphia.

Habitat.—Low woodlands in moist ground along streams; usually growing in large colonies.

Description.—Early flowering plant. Sherwood, Philadelphia, April 10, 1903. No. 5,159, Herb. W. S. Root-stalk slender with dried stolons of previous year still adherent. Flowers white, somewhat fragrant, 10 mm. broad, lower petal heavily lined with dark purple and lateral petals with two or three lines, all glabrous; sepals lanceolate, acute. Leaves thin, lighter beneath, glabrous; crenate, orbicular or the earliest reniform, cordate at base, 25 x 30 mm.; petioles 40 mm., glabrous.

Fruiting plants, Sherwood, June 17, 1903. No. 5,160, Herb. W. S. Leaves very thin, with a few scattered hairs above and on the veins beneath, size 80 x 90 mm.; petioles glabrous, 180 mm. long. Stolons very slender, 130 mm., still without leaves. Cleistogenes on some plants only, and very slender, their scapes 15 mm. long, horizontal. In later specimens, August 18, from Chester county, Pennsylvania, the stolons bear small leaves and a few minute cleistogenes. The sinus becomes much more open in the late summer leaves.

3. *Viola leconteana* Don.

Viola amoena Le Conte, 1828, Ann. Lyc. N. Y., II, p. 144 (*nec* Symonds, 1798).

Viola leconteana Don, 1831, Gen. Syst., I, p. 324.

Viola alsophila Greene, 1899, Pittonia, IV, p. 7.

Range.—Abundant in the mountains, extending southward in cold rocky woods to the lower Susquehanna in York and Lancaster counties, and the Brandywine below Chadd's Ford, Delaware county.

Habitat usually on damp shady rocky banks, though in the mountains it is found pretty generally throughout the forests, and is the most abundant violet.

Description.—Specimen in full flower. Chadd's Ford, May 10, 1902, B. H. Smith. No. 5,172, Herb. W. S. Flowers similar to the last, but 15 mm. broad; scapes 100 mm. long, spotted with red. Earliest leaves 25 x 25 mm., reniform, orbicular or somewhat ovate; later leaves ovate, 40 x 50 mm., slightly pubescent above, glabrous below; petioles red-spotted, 50 mm. long, glabrous. Scapes of the cleistogenes 25 mm. in length. Late summer fruiting plants have the leaves all ovate, usually rather acuminate, but they do not exceed 50 x 60 mm. in size; petioles, however, vary to 150 mm. in length.

As already stated, this and the preceding need more careful study, but I have not the necessary material at hand.

In the higher Alleghanies (Sullivan and Wyoming counties, also Fulton—Porter), *Viola renifolia* Gray grows with *V. leconteana*, and in its later stages bears considerable resemblance to it, as the leaves often become decidedly ovate in outline. The bristly pubescence of the petiole and veins on the under surface of the leaf, however, are in marked contrast to the smoothness of these parts in *V. leconteana*, while the upper surface in *V. renifolia* at this season is glabrous, instead of sparsely pubescent, as in the other species.

V. leconteana seems to be the most stoloniferous of any of the white acaulescent violets, but all of the *blanda* group exceed *V. primulæfolia* and *lanceolata* in this respect.

4. *Viola primulæfolia* Linn.

Viola primulæfolia Linn., 1753, Sp. Plant., pl. 934.

Viola p. bosci D. C., 1824, Prodrumus, I, p. 293.

Viola p. cordata D. C., 1824, Prodrumus, I, p. 293.

Range.—The southeastern counties of Pennsylvania, as well as in boggy places in Monroe county, and abundant in southern New Jersey, except the pine barrens, where it is replaced very largely by the next.

Habitat.—Open moist ground.

Description.—Early flowering plant. Tinicum, Delaware county, Pennsylvania, April 25, 1903. No. 5,153, Herb. W. S. Flowers white, 10 mm. broad, the lower petal strongly, the laterals slightly veined with dark purple, all glabrous; sepals lanceolate-acute; scape 40 mm., glabrous. Leaf ovate-oblong or oval, base decurrent; crenulate, 15 x 20 to 20 x 25 mm., glabrous, except base of midvein beneath and petiole which are pubescent, petiole 10 to 15 mm.

Older flowering plant. Tinicum, May 9. No. 5,154, Herb. W. S. Scapes 90 mm. Leaves almost or quite glabrous throughout, 35 x 23 mm., petiole 40 mm. Cleistogenes erect on scapes 20 mm. long.

Fruiting plant. Tinicum, June 21, 1903. No. 5,155, Herb. W. S.

Fruiting scapes 140 mm. long. Leaves 50 x 70, glabrous; petioles 150 mm. long; glabrous or with a few scattered hairs. Stolons just sprouting, 50 to 60 mm. long. In July and August specimens the stolons bear leaves 20 x 25 mm. on petioles 50 mm. in length, as well as small cleistogenes. In specimens from Willow Grove, Montgomery county, Pennsylvania, the main leaves reach the dimensions of 60 x 100 mm. on petioles 160 mm. in length, while the erect cleistogenes are on pubescent scapes 80 mm. long.

This species and the next are open-bog or wet-meadow violets, forming a very distinct group from the woodland, rocky-bank species which precede; and seem to be the southern representatives of the *blanda* group. We have thus two austral species and three boreal ones, the members of each group more closely related *inter se* than they are to any species of the other group. Among vertebrates in a similarly distributed lot of forms we should expect to find boreal and austral derivatives of the several types, but as before stated, in plants we seem to find that the most recent differentiations have taken place *within* the same life-zone, and that they are not zonal in their origin or distribution.

5. *Viola lanceolata* Linn.

Viola lanceolata Linn., 1753, Sp. Plant., pl. 953.

Viola attenuata "Sweet" Don, 1831, Gen. Syst., I, p. 322.

Range.—The southeastern counties of Pennsylvania, mainly along the Delaware and Susquehanna (also Monroe county—Porter), and abundant throughout southern New Jersey, where it is the most characteristic species of the pine-barren bogs, also up the Delaware to Warren county (Britton). About Philadelphia it is found only in the low grounds along the Delaware.

Habitat.—Wet open bogs or meadows, often growing with *V. primulaefolia*, and sometimes approaching it in early leaf-forms, but the flowers are always larger, and the later leaves abundantly distinct.

Description.—Early flowering plant. Tinicum, Delaware county, Pennsylvania, May 9, 1903. No. 5,156, Herb. W. S. Flowers 15 mm. wide, white, the lower petal strongly purple-veined, the laterals with one or two streaks; glabrous; sepals narrowly linear, acute, scapes glabrous, 100 mm. long. Leaves ovate-lanceolate, decurrent at base, 35 x 12 mm., obscurely crenulate glabrous, petioles glabrous, 30–40 mm. Cleistogenes on scapes 30 mm. long.

Later plants have leaves lanceolate, gradually decurrent, length including petiole 175 mm., width 15 mm. Flower scapes 170 mm.

Fruiting plant. Tinicum, June 28, 1903. No. 5,157, Herb. W. S.

Fruiting scapes 110 mm. Total length of leaves 180–320 mm., width 20–30 mm. Stolons 100 mm. in length on some plants bearing typical leaves and minute cleistogenes.

Viola sekirkii "Pursh" Goldie, which in foliage and general appearance resemble the *blanda* group, but differs in its pale blue flowers, grows plentifully in damp rocky situations in the hemlock forests of Sullivan and Wyoming counties, Pennsylvania, on the North Mountain; and has also been found in Monroe and Somerset counties (Porter).

6. *Viola papilionacea* Pursh. (Pl. XXXII, fig. i; Pl. XXXVIII, fig. iii.)

Viola papilionacea Pursh, 1814, Flor. Amer. Sept., I, p. 173.

Viola communis Pollard, 1898, Bot. Gazette, XXVI, p. 336 (*nec* Wittrock).

Viola domestica Bicknell, 1898, in Britton and Brown, Ill. Flora, III, p. 519.

Viola obliqua Britton and Brown, 1898, Ill. Flora, II, p. 447 (*nec* Hill).

Range.—The commonest violet through eastern Pennsylvania and New Jersey, though apparently not found on the higher Alleghanies, or in the pine barrens.

Habitat.—Meadows, fields, fence-rows, etc., also in low woodland.

Description.—Early flowering plant. Sherwood, Philadelphia, April 10, 1903. No. 5,119, Herb. W. S. Root-stalk thick and ribbed. Flower 20 mm. wide, deep violet-purple ("violet" of Ridgway's *Nomenclature of Colors*), the petals white at the base, the lower and lateral ones with dark lines, the latter also with a round patch of white hairs which is confined to the white basal area, other petals glabrous; the two upper ones usually recurved; sepals ovate-lanceolate, rather blunt; scape glabrous, 60 mm. long. Leaves cucullate, cordate in outline and distinctly crenate, 25 x 30 mm., glabrous; petiole pubescent on convex side, 40 mm. in length.

Later flowering plant. Media, Delaware county, Pennsylvania, April 26, 1903. No. 5,121, Herb. W. S. Exactly like the last, but leaves 40 x 50, petioles 80 mm., and scapes 100 mm.

Fruiting specimen. Media, June 4, 1903. No. 5,122, Herb. W. S. Leaves somewhat doubly crenate, 110 x 120 mm., petiole 275 mm., otherwise as before, fruiting scapes 80 mm. (apparently from cleistogenes). Other specimens, Sherwood, May 17, 1903, have cleistogenes in all stages of development on decurved peduncles 20 mm. in length, leaves 80 x 90 mm.

The general tendency in old leaves is to become widespread at the base, as contrasted with the narrow sinus of the early flowering season; and I can see no other character in *V. domestica* Bicknell that is not attributable to the rich soil of cultivated ground. Many other

species will become distinctly ranker than the wild plant when transferred to rich garden soil.

The above descriptions of *V. papilionacea* are taken from two colonies only. Many others examined agreed with them exactly in leaf characters, but a further examination may show some variation in shape of petals, extent of pubescence, etc., which I have not yet detected. The petals are usually recurved, sometimes very markedly so, as in specimens from the hilly woods bordering the Schuylkill at Gladwyn in which they are quite long and narrow. Woodland plants have usually bluer flowers.

As to the proper name for this species, I agree with Prof. Greene and Mr. Pollard in their latest decision that *papilionacea* Pursh is the earliest name based upon the present plant. It has a further advantage in apparently never having been used by subsequent authors for any other species, a decided point in its favor!

7. *Viola papilionacea* subsp.

I have found in dry upland woodland on Crum creek, Delaware county, a quite distinct ally of *V. papilionacea*, with a lighter root-stalk and more delicate foliage. Leaves more acuminate and rather more coarsely crenate, glabrous except for minute silvery appressed hairs scattered along the veins above; petioles glabrous, 180 mm. long; cleistogenes horizontal, not recurved; scapes 60 mm. in length. Only having fruiting specimens, May 17, 1903, No. 5,126, Herb., W. S., I am unable as yet to properly describe this form. Prof. Greene regards it as a distinct species.

8. *Viola affinis* Le Conte. (Pl. XXXI, fig. ii.)

Viola affinis Le Conte, 1828, Ann. Lyc. N. Y., II, p. 138.

Viola obliqua Pollard, 1901, in Britton's Manual, p. 636 (*nec* Hill).

Range.—Southeastern Pennsylvania and southern New Jersey exclusive of the pine barrens, apparently not extending to the mountains.

Habitat.—Rich woodlands.

Description.—Early flowering plant. Sherwood, Philadelphia, April 19, 1903. No. 5,103, Herb. W. S. Flowers 20 mm. in diameter, pale lilac ("lilac" of Ridgway), deepening into blue just at the junction with the white throat, darker purple veins on lower and lateral petals, bearding on lateral petals not entirely confined to the white area, but extending a little way on to the blue; lower petals slightly hairy at base; sepals ovate-lanceolate, acuminate; scapes 60–70 mm. long, glabrous. Leaves rather light green, somewhat cucullate; cordate, or

usually nearly triangular, 20 x 25 mm., rather coarsely crenate, glabrous; petioles 40–50 mm., glabrous.

Later specimens, Sherwood, April 29, 1903. No. 5,104, Herb. W. S. Scapes 70–100 mm. Leaves 30 x 40, wider at base and more attenuate at apex, cucullate and coarsely crenate, petioles 60–90 mm. A few cleistogenes present on scapes 25 mm. long.

Fruiting plants, Sherwood, June 17, 1903. No. 5,105, Herb. W. S. Leaves 70 x 80, coarsely and irregularly crenate-dentate, sometimes with very minute silvery hairs scattered on the veins above; petioles 160 mm., glabrous. Cleistogenes obliquely ascending or later deflexed, peduncles not more than 50 mm. long.

This species is well characterized by its general slenderness, thin, glabrous leaves, with coarsely crenate margins and pale flowers. At Sherwood it grows with *V. villosa cordifolia* and *V. palmata dilatata* in about equal abundance, and the three can be distinguished at a glance by foliage alone—*V. affinis* always glabrous, *V. villosa cordifolia* almost hispid-pubescent above, but glabrous beneath and on the petioles, and *V. p. dilatata* pubescent all over.

I would strongly advocate the use of Le Conte's name *affinis* for this violet. We not only know that this is what he had in view, but the name has been conceded to this species ever since its resurrection until Mr. Pollard, in Britton's *Manual*, foisted the old much-abused name *obliqua* of Hill upon it. Nobody knows what Hill's *obliqua* is, and the fact that no two persons seem to agree is argument enough that it should be discarded as unrecognizable along with *cordata* Walter and some others. Many other old names are difficult to identify with certainty, but where successive authorities have been in general agreement there is strong ground for their retention. To illustrate a little of the obscurity that surrounds *obliqua* of Hill, we may state that in 1896 Mr. Pollard applied it to *V. cucullata* + *papilionacea*. In 1898 he applied it to some form that he regarded distinct from either; then it was allotted to *V. papilionacea*, and now is again transferred to *affinis*. In marked contrast to his later views Mr. Pollard, when making his first application of the name, states that the species "is so well figured as to leave not the slightest doubt concerning the plant to which it refers." Prof. Greene, on the other hand, says "it does not half represent any violet that ever grew in any country," and calls attention to the fact that Pursh thought it applied to *V. blanda*, while Gray at one time suspected it to be *V. rotundifolia*! I give these opinions of *V. obliqua* simply to show the futility of attempting to use it in any sense.

9. *Viola cucullata* Ait. (Pl. XXXII, fig. ii; Pl. XXXVIII, fig. iv.)

Viola cucullata Aiton, 1789, Hortus Kewensis, III, p. 288.

Range.—Apparently throughout Pennsylvania and New Jersey, except the pine barrens, though the relative range of this and the two following has still to be worked out. One form at least occurs in the higher Alleghanies.

Habitat.—Swamps and wet meadows, often growing in the water in spring heads and shallow ditches. Plentiful about Philadelphia.

Description.—Flowering plant. Tinicum, Delaware county, Pennsylvania, May 9, 1903. No. 5,128, Herb. W. S. Flowers 20–25 mm. broad, pale blue (“campanula blue” of Ridgway) becoming darker toward the throat, which is white; lower and lateral petals lined with purple, the former glabrous, the latter with restricted patches of white beard; sepals rather long, lanceolate, acuminate; scapes glabrous, 150–180 mm. long. Leaves cucullate, cordate-ovate, crenate, glabrous, 35 x 45 mm. (the earliest more nearly orbicular, 25 x 30); petioles 80–90 mm., glabrous; peduncles of cleistogenes already 20 mm. in length.

Fruiting plant. Tinicum, May 23, 1903. No. 5,129, Herb. W. S. Leaves strongly cucullate, with very minute silvery hairs scattered along the veins above, otherwise glabrous; coarsely but regularly crenate, 70 x 75 mm.; petioles 260 mm.

Fruiting scapes and cleistogenes 225–300 mm. long. Some later fruiting cleistogenes (June 28) have peduncles 350 mm. in length.

This species is distinguished by its very long flower scapes and the enormous length attained by both scapes and petioles in fruiting plants. The cleistogenes are strictly erect, and the blades of the leaves never reach the size of *V. papilionacea*; the blue, not purple, flowers are also characteristic. The two races which follow are closely related, and have not yet been studied from very large series. Thinking the specimens I had might be different from *V. cucullata*—especially No. 5,132—I submitted them to Prof. Greene, and he identified them as his new species *V. macrotis* and *V. leptosepala*.

10. *Viola cucullata macrotis* (Greene).

Viola macrotis Greene, 1902, Pittonia, V, p. 97.

Range.—Shady swampy spots in western New Jersey, between the pine barrens and the Delaware; doubtless elsewhere as well.

Description.—Flowering plants, Medford, New Jersey, May 5, 1903. No. 1004, Herb. W. S. Similar to *cucullata*, but flowers larger; petals very broad; leaves usually with larger blades, less cucullate and thinner; sepals minutely ciliate on the margins, and scapes and petioles often with a few scattered hairs.

11. *Viola cucullata leptosepala* (Greene).

Viola leptosepala Greene, 1902, Pittonia, V, p. 98.

Range.—Shady bogs, western New Jersey; probably more extended.

Description.—Flowering plants, Springvale, Camden county, New Jersey, May 10, 1903. No. 5,132, Herb. W.S. Generally similar to *cucullata*, but much more slender and delicate and plants solitary; leaves more elongate; flowers large, with remarkably long, slender sepals, 12 mm. long and less than 2 in width. Scapes and petioles very slender and with scattered hairs, most plentiful on the lower part.

12. *Viola crenulata* Greene. (Pl. XXXII, fig. iii.)

Viola crenulata Greene, 1901, Pittonia, IV, p. 295.

Range.—Only detected in Tinicum, Delaware county, Pennsylvania, as yet.

Habitat.—Open wet meadows and swamps, but in drier spots than *V. cucullata*.

Description.—Flowering plant. Tinicum, Delaware county, Pennsylvania, April 25, 1903. No. 5,127, Herb., W. S. Flowers pale lilac-blue, darker near the base of the petals, throat white, 12 mm. in diameter; petals slender, the lower rather broad, slightly pubescent at base; laterals with conspicuous bearded patch; sepals slender lanceolate; scapes 80 mm., glabrous. Leaves triangular-cordate, much attenuated at apex, pale green, glabrous, except for very minute appressed scattered hairs on the veins above, size 20 x 28, coarsely crenate (earliest leaves less pointed); petioles 50 mm.; cleistogenes already 25 mm. high.

Late summer plants (August 15, 1903), past the fruiting stage, have leaves 35 x 40, but otherwise exactly like the earlier ones; petioles 90 mm. long, which evidently represents the maximum growth of this little plant.

This delicate little violet, while related to the *cucullata* group, is very distinct, differing in the color of both flowers and leaves, in the shape of the latter and the very small size, being smaller in late summer than *V. cucullata* when it is in early flower. The April specimens above described had evidently been in flower some time, as evidenced by the development of the cleistogenes.

13. *Viola villosa cordifolia* Nutt. (Pl. XXXI, fig. i.)

Viola villosa cordifolia Nuttall, 1818, Genera, I, p. 148.

Viola sororia nuttallii Don, 1831, Gen. Syst., I, p. 324.

Viola cucullata var. *cordata* Gray, Manual, 5th ed., p. 78, in part (prob. not *cordata* Walter).

Viola ciliata Muhl., 1813, Cat., p. 26.

Range.—Pennsylvania, apparently not extending to the higher

mountains; the northern and middle counties of New Jersey, and rarely in Camden county, but not in the pine barrens.

Habitat.—High dry woodland.

Description.—Early flowering plant. Sherwood, Philadelphia, April 10, 1903. No. 5,100 Herb. W. S. Flowers red-purple (near “aster-purple” of Ridgway), white in the throat; but slightly veined; upper petals rounded, not at all recurved; lateral petals bearded near the base, as in *affinis*, but lower petal often nearly glabrous; width of flowers 15–18 mm.; sepals lanceolate or ovate-lanceolate, rather obtuse; scapes 40–50 mm., glabrous. Leaves dark green, silvery-pubescent above, glabrous and reddish beneath, and frequently prostrate on the ground; reniform orbicular or cordate, crenate, 20 x 25 mm.; petioles 30–40 mm., glabrous and reddish at base. Later specimens, April 29, have leaves ovate-cordate, 25 x 35 mm., and bear horizontal cleistogenes on peduncles 30 mm. long.

Fruiting plant, Sherwood, June 17, 1903. No. 5,102, Herb., W. S. Leaves round-cordate, 65 x 70 mm.; petioles 110 mm. long; fruiting scapes 60 mm. These later leaves are usually erect, and not prostrate like the earliest ones, and are sometimes slightly cucullate.

This violet is at all times distinguished by the almost bristly, silvery-pubescent on the upper surface of the leaves and by its dark reddish-purple flowers. There would seem to be two separable forms confused under the name *villosa*, as Prof. Greene tells me that the plant I have described above is not true *villosa*, to which I had unhesitatingly referred it, and states that he knows both plants well. The type of *villosa* came from South Carolina, and if the form found there is distinct from the present plant, Walter's name unquestionably belongs to it. Nuttall seems to have been the only writer to recognize two forms of this type of violet, and he based his *V. cordifolia* upon specimens from “dry woods on the banks of the Schuylkill near Philadelphia.” That his description applies to the above plant seems to me beyond question, and I have, therefore, adopted it.

An examination of Muhlenberg's herbarium shows that his *V. ciliata* is either the above or true *villosa*. That his names as they stand are mere *nomina nuda* is emphasized by the general assumption that in this instance he had *V. fimbriatula* in mind!

14. *Viola palmata* Linn. (Pl. XXXIV, fig. i; Pl. XXXIX, fig. i.)

Viola palmata Linnæus, 1753, Sp. Plant., p. 933.

Range.—So far detected only in Tinicum township, Delaware county, and near Valley Forge, Pennsylvania.

Habitat.—Dry, shaded localities.

Description.—Flowering plant. Tinicum, Delaware county, Pennsylvania, May 3, 1902. No. 2,601, Herb. W. S. Flowers large, 25 mm. broad, deep violet-purple, conspicuously bluer toward the base of the petals, which is white; pubescence restricted to white area on lateral petals; lower petal glabrous; sepals ovate-lanceolate, broad, and rather blunt; scapes slightly pubescent, 120 mm. long. Leaves moderately pubescent above and below; earliest 20 x 25 mm., later ones 45 x 50 mm.; much lobed, but none of the incisions reaching more than half-way to the base; petioles pubescent, 90–120 mm.; cleistogenes on short horizontal peduncles 30 mm. long.

Later plants, June 28, similar, but leaves nearly glabrous, except on the veins beneath, size 80 x 110 mm.; petioles 180, cleistogenes short, deflexed. Late summer leaves reach the dimensions of 120 x 150 mm., with petioles 300 mm. in length.

The apparent rarity of this violet would make me hesitate in regarding it as a separate form were it not for its very distinct characters and the assurance of Prof. Greene. Probably I have not yet discovered its stronghold, or perhaps it is rare in the vicinity of Philadelphia, but plentiful elsewhere.

15. *Viola palmata dilatata* Ell. (Pl. XXXIII; Pl. XXXIX, figs. iv and v.)

Viola palmata dilatata Elliot, 1817, Bot. of S. C. and Ga., I, p. 300.

?*Viola palmata fragrans* Elliot, 1817, Bot. of S. C. and Ga., I, p. 300.

?*Viola palmata vulgaris* Elliot, 1817, Bot. of S. C. and Ga., I, p. 300.

?*Viola palmata esculenta* Elliot, 1817, Bot. of S. C. and Ga., I, p. 300.

Viola heterophylla Muhl., 1813, Cat., p. 25 (*nec* Poiret).

Viola triloba Schw., 1822, Amer. Jour. Sci., V, p. 57.

?*Viola congener* Le Conte, 1828, Ann. Lyc. N. Y., II, p. 140.

?*Viola sororia* Willdenow, 1806, Hort. Berol., Pl. LXXII.

Viola asarifolia Pursh, 1814, Flor. Am. Sept., Suppl., p. 732 (*nec* Muhlenberg).

Range.—Eastern Pennsylvania and New Jersey exclusive of the pine barrens.

Habitat.—Dry upland or sandy woods and shady localities.

Description.—Early flowering plant. Sherwood, Philadelphia, April 29, 1903. No. 5,106, Herb. W. S. Flowers large, rich purple, with darker lines on lower petals, white at base of petals; pubescence in rounded patch in white area on lateral petals; lower petal slightly pubescent at base; width of flower 20 mm.; sepals broadly ovate-lanceolate, rather blunt; scapes glabrous, 50–70 mm. long. Leaves 30 x 35 mm., cordate, coarsely crenate or variously 3- to 5-lobed, divisions not usually deeply cut; pubescent on both sides as well as the petioles, which are 40–50 mm. long.

Later plants, Sherwood, May 17, 1903. No. 5,107, Herb. W. S.

Similar leaves 50 x 60 mm.; petioles 100–110 mm.; scapes 90–100 mm.; cleistogenes horizontal or slightly ascending, 20–40 mm. long.

Fruiting plants, June 17, 70 x 80–80 x 100 mm.; petioles 225 mm. long, fruiting cleistogenes 50–60 mm. long.

A glance at Pl. XXXIII will show to what extent the leaves of this violet vary; all sorts of forms may occur on one plant, or we may have plants with the leaves all uncut.

The latter are supposed to be the basis of Willdenow's *Viola sororia*. I fail to see, however, on what grounds this can be regarded as a separable form, even as a subspecies, as is done in Britton's *Manual*. On the other hand, if we regard it as the same as *dilatata*, it must supersede it, being an older name. To my mind the same arguments apply here as in the case of *V. obliqua* Hill. Nobody can ascertain what the original plant was, and in view of the various uses to which the name has been put, it had best be discarded as unrecognizable.

The several other varieties given by Elliot are probably not separable from this, and Schweinitz specimens which I have examined prove his *triloba* to be the same thing, while *heterophylla* Muhl. and *asarifolia* Pursh, while probable referable to this, are neither of them available. This is one of the most common woodland violets found about Philadelphia, and may be recognized from any (except the next) by its uniform pubescence, which is especially marked on very young leaves, though disappearing to some extent on the large foliage of late summer.

16. *Viola palmata variabilis* (Greene).

Viola variabilis Greene, 1902, Pittonia, V, p. 91.

Range.—Apparently higher ground, nearer to the mountains or foothills.

Habitat.—Dry woodlands.

Description.—A close ally of the preceding, but smaller and much more pubescent, quite villose on young leaves. Flowers similar but leaves more deeply divided and with fewer uncut leaves. Specimens from Argus, Bucks county, Pennsylvania, May 8, 1903, Stewardson Brown, No. 5,110, and June 8, Dr. C. D. Fretz, No. 5,111, Herb. W. S.

These plants have been identified as *V. variabilis* by Prof. Greene, while the former, which I have called *dilatata*, he considers not sufficiently pubescent and in other ways unlike this form. It may be that further study with more material may show that they are not distinguishable.

17. *Viola palmata angellæ* (Pollard). (Pl. XXXIV, fig. ii.)

Viola angellæ Pollard, 1902, *Torreyia*, II, No. 2, p. 24.

Range.—Found so far only in the neighborhood of Cheyney, Chester county, Pennsylvania.

Habitat.—Rich woodland.

This violet (No. 3,094, Herb., W. S.) I collected on June 22, 1902, it being then well past the flowering stage. Comparison with typical specimens from Orange, New Jersey, kindly sent me by Miss Lillie Angell, seems to prove the identity of the two, and Prof. Greene coincides with my identification. All the leaves, even the earliest (which are still retained), are cut, the later ones having the incisions rather rounded at the base, and the lobes, except the middle, are quite uniform. The difference in the appearance of the leaves between this and the other forms can be seen by comparing the figures on the plate. The petioles and the veins on the under side of the leaf are quite pubescent, but the upper surface is but slightly so. Leaves 70 x 75 mm.; petioles 150–175 mm. long. Cleistogenes on deflexed or prostrate peduncles 20 mm. in length.

18. *Viola septemloba* Le Conte. (Pl. XXXV, fig. ii; Pl. XXXIX, fig. iii.)

Viola septemloba Le Conte, 1828, *Ann. Lyc. N. Y.*, II, p. 141.

Range.—Apparently a southern species, ranging across the southern border of Pennsylvania. I have it from Kennett Square and several miles north of Coatesville, both in Chester county.

Habitat.—Low moist woodland.

Description.—Flowering plants. Kennett Square, May 7, 1903, C. J. Pennock. No. 5,112, Herb. W. S. Flowers very large, 25 mm. broad, violet-purple, distinctly darker blue near the base of the petals, white basal area well developed; upper petals particularly large, 10 x 20 mm.; lower petals glabrous and beard on laterals short and restricted; sepals very broad and relatively short; scapes 125 mm. long, glabrous. Leaves all deeply cut, except some of the earliest, in which the indentations are slight; segments of the later leaves taper rapidly to scarcely more than a millimeter in width at base; 7 to 9 principal divisions; earliest leaves 30 x 35, later 50 x 60 mm., glabrous, except for a fringe of very minute hairs on the later leaves; petioles respectively 50 and 120 mm., glabrous; cleistogenes 30 mm. long.

Fruiting specimens. Kennett Square, May 25, 1902. No. 5,113, Herb. W. S. Leaves 90 x 100 mm., with some very minute hairs above and on the margin, but appearing glabrous; petioles 320 mm. long, glabrous; cleistogenes in fruit on peduncles 100 mm. long.

This beautiful and distinct violet I have long considered to be

Le Conte's *septemloba*, a species not recognized in any of our manuals, and I am much gratified to have Prof. Greene's endorsement and statement that it matches well the water-color drawing of Le Conte in his possession.

Its large flowers, only matched by *V. brittoniana*, its peculiarly lobed, essentially glabrous leaves, and its great size in late summer—some plants measure 15 inches in height—serve easily to distinguish it from any other violet.

19. *Viola brittoniana* Pollard. (Pl. XXXV, fig. i; Pl. XXXIX, fig. ii.)

Viola atlantica Britton, 1897, Bull. Torrey Bot. Club, XXIV, p. 92 (*nec atlantica* Pomel, 1874).

Viola brittoniana Pollard, 1898, Bot. Gazette, XXVI, p. 332.

Range.—All along the New Jersey coast, and at points in the southern pine barrens (Egg Harbor and Tuckahoe), also up the Delaware valley, occurring at Springdale, Camden county, New Jersey, and Tullytown, Bucks county, Pennsylvania.

Habitat.—Damp, sandy, open ground.

Description.—Flowering plant. Springdale, New Jersey, May 10, 1903. No. 5,114, Herb. W. S. Flowers very large, 28 mm. across, rich violet, inclining to lilac (somewhat lighter than Ridgway's "aster-purple"), without any deeper blue tint near the base of the petals, such as is found in the preceding cut-leaved species; white area of the throat extended especially on the upper petals, pubescence on lateral and lower petals short but spreading out beyond the white area, a scattering of hairs on the upper petals as well, sepals narrowly lanceolate-acute; scape glabrous, 125 mm. in length. Leaves all much divided, earliest ones reddish beneath, divisions extending about three-quarters of the distance to the base, middle segment much broader than the others, size 30 x 30 mm.; later leaves divided to the base into three segments, and each of these again divided almost to the base, making nine irregularly toothed, nearly equal narrow lobes; size 70 x 75. The leaves appear glabrous, but have a scattering of exceedingly minute hairs, scarcely discernible to the naked eye, on the upper surface and margin; the later leaves are decidedly cucullate; petioles 90 mm. long, those of earliest leaves 30–40 mm.

Fruiting plant. Springdale, June 27, 1903. No. 5,115, Herb. W. S. Leaves 70 x 90 mm., petioles 225 mm.; cleistogenes on erect peduncles 150–200 mm. tall. The late foliage seems somewhat harsh to the touch, probably due to the minute marginal pubescence. This very distinct violet seems to have escaped the notice of all the early writers, and

had not Dr. Britton been unfortunate in selecting for it a name already used for a foreign species, it would have no synonyms. The foliage represents the extreme of the palmately cut species; some leaves have the central lobe wider than the others, but the narrow lobes are the rule, and I have yet to see an uncut leaf even among the earliest, though such a reversion is quite likely to occur occasionally in any of these violets. In the uniformly colored flowers and tall, erect clistogenes, this species departs widely from all the foregoing.

In the Springdale colony are one or two stocks which look decidedly different, though obviously *brittoniana* in whole or in part—if we admit the possibility of occasional hybridism. These have the lobes of the leaves less deeply cut, the central lobe much wider than the others, and altogether recall strongly the extreme forms of *V. emarginata* (Pl. XXXVI, fig. v). The leaf is too round in outline for that species, but the resemblance shows how curiously interrelated these acaulescent violets are and what cases of parallel development occur. *V. brittoniana* \times *V. cucullata* would, to my mind, produce just such a plant as this, and at this spot they both occur intermingled. On the other hand, it may equally as well be regarded as an aberrant form of *V. brittoniana*. The small number of plants and the association with large numbers of the other species should, to my mind, deter any one from naming such a form as this, but I fear they have not always done so in the past.

20. *Viola pedata* Linn.

Viola pedata Linnæus, 1753, Sp. Plant., p. 933.

Viola multifida Mill., 1768, Dict., 8 ed. (*vide* Greene).

Viola pedata atropurpurea "Raf." D. C., 1824, Prodr., I, p. 291.

Viola pedata bicolor "Pursh," "Raf." D. C., 1824, Prodr., I, p. 291 (in synonymy).

Range.—I have found this species only near Mortonville, Chester county, Pennsylvania, but have heard of it from other points in this county and Delaware. In Britton's *New Jersey Catalogue* it is recorded from Phillipsburg, Belvidere and Oxford.

Habitat.—Dry sandy banks.

Description.—Without satisfactory material, I may merely say that this differs from the next in having the upper petals deep velvety purple. There may be other differences, but I am not prepared to discuss them. I must confess, however, that I have much doubt whether this is really a distinct form from the next, as they grow so intimately intermingled. In case it is regarded as an individual variation only, then the name *pedata* will cover them both.

21. *Viola pedata lineariloba* D. C.

Viola pedata lineariloba D. C., 1824, Prodr., I, p. 291.

?*Viola pedata ranunculifolia* D. C., 1824, Prodr., I, p. 291.

Viola pedata inornata Greene, 1896, Pittonia, III, p. 35.

Range.—Southeastern counties of Pennsylvania and in southern New Jersey (apparently not in the typical pine barrens). To the northward it ranges to Monroe, Northampton, Lancaster and Huntingdon counties in Pennsylvania (Porter), and to several stations in the northern counties of New Jersey—Sussex, Essex, Union, Somerset, Warren and Hunterdon (Britton).

Habitat.—Dry sandy banks, or sandy open woods and clearings, necessarily local, though often very abundant. The nearest stations to Philadelphia are the serpentine outcrops of Delaware county and sandy pine woods near Springdale, New Jersey.

Description.—Early flowering plant, Media, Delaware county, Pennsylvania, April 26, 1903. No. 5,117, Herb., W. S. Flowers large, flat—*i.e.*, petals nearly in one plane—20–35 mm. in diameter, all glabrous, and without darker lines, blue (or occasionally lilac or white), stigma not bearded nor rostrate; sepals long, linear-lanceolate; scapes glabrous, 70–90 mm. (stunted plants in very barren soil have them much shorter). Leaves glabrous, all divided into 7 to 11 linear lobes, toothed at the end; the earliest leaves have the lobes less numerous and spatulate; size 15 x 18 mm.; later leaves 25 x 25 mm.; petioles 20–50 mm., glabrous.

Late fruiting plants, Media, June 4. No. 5,118, Herb., W. S. Leaves 45 x 50, petioles 100 mm. long. Fruiting scapes 80 mm. No cleistogenes are produced in this species.

The variety of size, both in plants and flowers, owing to the nature of the soil, is very great. I have specimens in full bloom in which the leaves are 2 inches high and the flowers 3, while from another locality I have plants of apparently the same age in which the leaves reach six inches and the flowers 7. Some anomalous plants collected in late summer have very broad segments to the leaf—in fact, they are sometimes reduced to coarse teeth—and are minutely pubescent. These I take to be a second crop of leaves, produced through some unusual activity, or perhaps due to arrested development in spring, since the leaves usually wither away by midsummer. Such plants have, moreover, been collected in full flower in late August and September. The lobing of *Viola pedata* and *V. p. lineariloba* is on a different plan from that exhibited in the foregoing cut-leaved species. In all palmate or pedate violets the primary division is in three parts. In *V. palmata dilatata* the process frequently stops at the trilobed stage, but in *V. sep-*

temloba the middle segment regularly divides in three, and the lateral ones into two, while in *V. brittoniana* each segment divides into three. There are, of course, some deviations, but these are the normal types of leaf in the several species. In the *pedata* group, however, the central lobe does not divide, while the lateral ones in typical leaves are four-parted. Occasionally *V. brittoniana* comes very near to this type by producing only one lateral lobe to the middle segment, and in one leaf in my collection it is undivided. This denotes a tendency toward the *pedata* type, which must be the extreme of development in this direction.

If this form is regarded as separable from the preceding it must bear DeCandolle's name *lineariloba*, which has priority over Prof. Greene's *inornata*. Both are based upon the same plate of Curtis' *Botanical Magazine*.

22. *Viola fimbriatula* Smith. (Pl. XXXVII, figs. i-iii; Pl. XXXVIII, fig. v.)

Viola primulaefolia Pursh, 1814, *Flora Am. Sept.*, I, p. 173 (*nec* Linn.).

Viola fimbriatula Smith, 1817, *Rees' Cyclop.*, XXXVIII.

Viola ovata Nuttall, 1818, *Gen.*, I, p. 148.

Viola ovata belvisiana D. C., 1824, *Prodr.*, I, p. 294.

Viola sagittata hicksii Pollard, 1895, *Bot. Gazette*, XX, p. 326.

Range.—From the lower mountains to the coast, through eastern Pennsylvania and central and southern New Jersey (not plentiful in the pine barrens).

Habitat.—Dry sandy or rocky banks and fields.

Description.—Flowering plant, Media, Delaware county, Pennsylvania, April 26, 1903. No. 5,145, *Herb.*, W. S. Flowers 10–15 mm. broad, purple (between “aster-purple” and “violet” of Ridgway); petals white at the base, the lower one lined with darker; lateral petals with conspicuous patch of beard, lower one slightly pubescent; sepals lanceolate; scape pubescent, 30 mm. long. Leaves ovate-cordate, obscurely crenate, except at base, where teeth are more conspicuous, 15 x 20–18 x 30; thick and very pubescent, especially above; decurrent on the petiole, which is also densely pubescent, 12–18 mm. long.

Later flowering specimens have leaves 28 x 45 mm., petioles 35 mm. and scapes 60 mm. in length.

Fruiting plant, Media, June 4, 1903. No. 5,146, *Herb.*, W. S. Pubescent all over; scapes 70 mm.; leaves 45 x 75 mm.; petioles 45–60 mm.; cleistogenes erect, 45 mm. high.

In some very dry exposed spots this species becomes quite stunted, but flowers profusely. A root from Gladwyn, April 26, has leaves only 7 x 12 mm., petioles 5 mm., but bears seven flowers on scapes 35 mm.

in length. The leaves are always very numerous, and owing to the short petioles—usually less than the blade—they appear very much crowded. Sometimes the teeth at the base are scarcely larger than the other crenations, while in other specimens two or three of them are quite prominent, showing an approach to *V. sagittata*.

The above descriptions apply to typical *V. fimbriatula*, but the plant is exceedingly variable and notwithstanding the fact that in their typical forms the present species and *V. sagittata* are abundantly distinct, there occur forms which are about as nearly intermediate as they can well be, so that the old practice of making one a subspecies of the other is by no means as absurd as Mr. Pollard would have us believe (*Proc. Biol. Soc. Wash.*, X, p. 89). One form which occurs abundantly near Christiana, Lancaster county (Pl. XXXVII, fig. ii), has leaves truly sagittate, 20 x 70 mm., with petioles more than twice as long. The whole plant is strongly pubescent, and the early leaves ovate. Prof. Greene identifies it as "uncommonly long-leaved *fimbriatula*." The step from this to the pubescent *sagittata* described beyond is surely very short. It is possible that there may be a separable intermediate form, but the question will bear more study before the true status of these intermediates is determined. In another direction *V. fimbriatula* approaches the leaf-form of *V. papilionacea*, and this form which is quite sharply defined has been named by Prof. Greene *V. aberrans*.

23. *Viola fimbriatula aberrans* (Greene). (Pl. XXXVII, figs. iv-vi.)

Viola aberrans Greene MSS.

Range.—Apparently coincides with that of the former.

Habitat.—Dry sandy and rocky banks, usually with *V. fimbriatula*, but less abundant, and always easily distinct.

Description.—This is essentially a long petioled *V. fimbriatula*, with broad, cordate, somewhat cucullate leaves, without strong basal teeth and usually somewhat less pubescent.

Flowering plant, Media, Pennsylvania, April 26, 1903. No. 5,147, Herb., W. S. Similar to preceding, but leaves 18 x 30 mm.; petioles 60 mm.; scapes 100 mm.

Fruiting plant, Media, June 4. No. 5,148, Herb., W. S. Leaves 75 x 100 mm.; petioles 210 mm.; cleistogenes horizontal, 30 mm. long.

This is a very well-marked form, though not common in the immediate vicinity of Philadelphia. Mr. Pollard's *V. porteri* does not seem to occur in this vicinity at all, so that I have been unable to study it. I should, however, have very grave doubts about referring it to *V. dentata* of Pursh, which grows "in wet meadows and woods"! I fail to see the advantage of trying to utilize old names which are

coupled with such conflicting statements as this. I am aware that some forms of the *fimbriatula* group with nearly or entirely glabrous foliage occur in the New Jersey coast districts, but have not as yet had opportunities for studying them.

24. *Viola sagittata* Ait. (Pl. XXXVI, figs. i-iii; Pl. XXXVIII, fig. i.)

Viola sagittata Aiton, 1789, Hort. Kewensis, III, p. 287.

Range.—Southeastern Pennsylvania, central and northern New Jersey, southward through the Delaware valley.

Habitat.—Moist meadows (forms occur also in dry ground).

Description.—Flowering plant, Tinicum, Delaware county, Pennsylvania, April 25, 1903. No. 5,133, Herb., W. S. Flower 15–18 mm. broad, dark purple (“violet” of Ridgway); all petals strongly veined with a darker shade, bases white, sometimes running out on upper petals to form a white spot at the point where they are reflexed; beard on laterals in a large basal patch, from which a scattered pubescence extends on to the purple area; base of lower and often exposed part of upper petals pubescent; upper petals usually large, rounded and nearly flat, and sometimes emarginate. Sepals linear-lanceolate, acute; scape glabrous, 50 mm. long. Leaves somewhat variable, the earliest nearly triangular, the others ovate-oblong or sagittate, generally rounded at the apex, crenate, with two or three prominent teeth at the base, glabrous, 8 x 12–12 x 25 mm.; petioles 15–45 mm., glabrous.

Later specimens, Tinicum, May 9, 1903, nearly out of bloom. Foliage quite glabrous throughout, leaves 12 x 45, sagittate, acute; petioles 90–110 mm.; scapes 100–140.

Fruiting plants, Tinicum, May 23, 1903. No. 5,135, Herb., W. S. Leaves strongly auriculate-toothed at base, 80 x 20 mm., 40 mm. across base, petioles 150 mm. Cleistogenes erect on peduncles 150 mm. tall. Specimens from near Haddonfield, New Jersey, June 27, 1903, No. 5,138, Herb., W. S., have leaves 100 mm. long and 60 mm. across the base; petioles 220 mm. These plants are somewhat pubescent, notably on the margins of the leaves, and present some forms perplexingly like *emarginata* (Pl. XXXVI, fig. iv). Others, to all appearances *sagittata* in leaf, form, etc., from dry sandy hill-sides near Newtown Square, Pennsylvania, are quite pubescent on both blades and petioles as well as on the scapes. These require further study.

25. *Viola emarginata* Nutt. (Pl. XXXVI, figs. iv-v; Pl. XXXVIII, fig. ii.)

Viola emarginata Nuttall, 1818, Genera, I, p. 147.

Range.—Southeastern Pennsylvania and southern New Jersey

mainly east of the pine barrens, but quite across the Cape May peninsula.

Habitat.—Low sandy ground or sandy woodland.

Description.—Flowering plants, Tinicum, Delaware county, Pennsylvania, April 25, 1903. No. 5,141, Herb., W. S. Flowers 15 mm. wide, blue, close to the color of the double cultivated species (between “campanula blue” and “mauve” of Ridgway), base white, lower and laterals with dark lines, beard spreading from the basal spots on to the blue area, lower petal and upper ones as well pubescent with scattered hairs; petals all rather broad and rounded, lower one almost cup-shaped and truncate, all distinctly emarginate; sepals lanceolate-acute; scapes 60–80 mm. Leaves thick, fleshy and glabrous, nearly triangular, crenate, with basal teeth slightly more prominent, decurrent, 15 x 25 mm.; petiole glabrous, 40 mm. Later specimens, May 9, have erect cleistogenes on peduncles 75 mm. high.

Fruiting plants, Tinicum, June 21, 1903. No. 5,143, Herb., W. S. Leaves 50 x 5 mm., strictly triangular, margin dentate-crenate, coarser toward the base, petioles 200 mm., peduncles of cleistogenes 120 mm. high.

This seems to be the typical *V. emarginata*. Other colonies in Cape May county, New Jersey, have the summer leaves very broad across the base, with the teeth enlarged into deep lobes (Pl. XXXVI). Still others in Chester county, Pennsylvania, in woodland, develop leaves 90 x 90 mm., much expanded and lobed at base; petioles 300 mm. long! I have not had the opportunity of studying either of these last in flower, so cannot state whether their blossoms conform in color to the Tinicum plants. The leaves of the Chester county specimens, while still thick and fleshy, are slightly but minutely pubescent.

The above descriptions will give some idea of the immense variability of the *sagittata* group, comprising numbers 22–25. *V. fimbriatula* seems to be the nearest to the supposed parent or *papilionacea* type. From it we pass to *sagittata*, of which *emarginata* seems to be an extreme development, with apparently a marked deviation in floral characters. The resemblance in leaf-form between *emarginata* and some aberrant *brittoniana* has already been commented upon. Whether the apparent intergrades which serve to confuse the *sagittata* group are really such, or the extremes of a somewhat variable species, is a difficult matter to determine.

II. CAULESCENT SPECIES.

I.—Flowers yellow.

a.—Plants strongly pubescent, *V. pubescens*.

aa.—Plants nearly glabrous, *V. scabriuscula*.

II.—Flowers lilac-purple, *V. muhlenbergii*.III.—Flowers white or cream-colored, *V. striata*.IV.—Flowers white tinged with yellow and blue, stipules very large and laciniate, leaves small, mostly lanceolate, *V. rafinesquii*.

The caulescent violets in the vicinity of Philadelphia are much less variable than the acaulescent forms, and the species are much more sharply defined.

The yellow-flowered group is the most generally distributed.

26. *Viola pubescens* Ait.

Viola pubescens Aiton, 1789, Hort. Kewensis, III, p. 290.

Viola pensylvanica Michaux, 1803, Flor. Bor. Am., II, p. 149.

Viola pubescens eriocarpon Nuttall, 1818, Genera N. A., Pl. I, p. 150.

Range.—Southeastern Pennsylvania northward to Pike and Monroe counties (Porter), but apparently not on the higher Alleghanies; in New Jersey throughout the northern counties south to Monmouth (Britton).

Habitat.—Dry woodland.

Description.—Flowering plant, Elwyn, Delaware county, Pennsylvania, April 27, 1902. No. 2,583, Herb., W. S. Stem strongly pubescent, almost villous; stipules ovate, acuminate, nearly glabrous, except on the margin; leaves strongly pubescent above and below, reniform, cucullate, dentate, 40 x 55 mm.; petioles pubescent, 20–35 mm. Flowers yellow, the lower and lateral petals lined with very dark purple, a small spot of pubescence near the base of the laterals, 15–18 mm. broad; sepals linear-lanceolate; pedicels pubescent, 30–45 mm. long. These plants are about 150 mm. high; about two-thirds up a large leaf branches off dichotomously with the upper part of the stem, usually with a long pediceled axillary flower; the upper part of the stem bears several partly grown leaves and one or two short-stalked flowers; there are no radical leaves. Sometimes two stems rise from the same root, and one is often shorter than the other, bearing only one flower and two leaves.

Later fruiting plants are 300 mm. high, with four reniform or nearly triangular leaves, successively smaller, and two or three axillary seed-pods on successively shorter pedicels; pod 12 mm. long, sometimes glabrous and sometimes pubescent; the stem is now nearly erect, making the first leaf entirely lateral. There are often one or two reniform radical leaves on petioles 160 mm. long.

A specimen from Willow Grove, Montgomery county, Pennsylvania, July 16, 1902, No. 3,319, Herb., W. S., has developed branches at the summits of the fruiting pedicels, which have produced one or two smaller pods, apparently from cleistogamic flowers, and several small leaves, those on the lowest pedicel being orbicular, 20 mm. in diameter.

It seems certain that Nuttall's var. *eriocarpon* from Philadelphia is nothing more than an individual variation of this species. The pubescence of the pods is variable and not correlated with any other characters.

27. *Viola scabriuscula* Schw.

Viola scabriuscula Schweinitz, 1822, Am. Jour. Sci., V, p. 75.

Range.—Southeastern Pennsylvania to the highest mountains of Wyoming county, also northern New Jersey south to Trenton (Britton).

Habitat.—Damp woods along streams.

Description.—Flowering plant, Crum creek, Delaware county, Pennsylvania, April 10, 1903, No. 5,162, Herb., W. S. Stem glabrous or nearly so, often recumbent; leaves nearly glabrous, but with pubescence on the veins below, finely dentate-crenate, reniform, 20 x 30 mm.; stipules similar to *pubescens*; petiole (of first leaf) 30 mm., glabrous. Flower yellow, closely resembling the preceding species; pedicel glabrous, 20 mm. long. Plants 90 mm. in height. The first leaf and its flower clearly overtop the rest of the upper stem in this species at this stage, and the flower of the latter seems to be frequently cleistogamic. In *pubescens* the two flowers are about on a level and both flower at once. There are always two or three radical, reniform, glabrous leaves on pedicels 30 mm. long, and often several stems from one root.

Fruiting plants, Crum creek, May 17, 1903. No. 5,164, Herb., W. S. Plants 350 mm. tall, bearing three nearly triangular or slightly reniform leaves, coarsely dentate, crenate, 50 x 60 mm., with usually one seed-pod and a cleistogamic flower. Pods 10 mm. long, white, woolly or glabrous on contiguous plants. There are usually several smaller radical leaves. The pubescence of the pods seems to be purely an individual character, and is more variable than in *V. pubescens*.

Viola hastata occurs on the southern Alleghanies of Pennsylvania, north to Blair county, but not eastward.

28. *Viola striata* Ait.

Viola striata Aiton, 1789, Hortus Kewensis, III, p. 290.

Viola ochroleuca Schweinitz, 1822, Am. Jour. Sci., V, p. 69.

Range.—Southeastern Pennsylvania, in the river valleys. Very plentiful in the lower Susquehanna, also on the Brandywine at Chadd's Ford. Near Philadelphia it occurs only at Bartram's Garden, where

it is supposed to be native. In New Jersey, south to Trenton (Britton).

Habitat.—Low ground along streams.

Description.—Flowering plants, Bartram's Garden, Philadelphia, May 13, 1901. No. 1,083, Herb., W. S. Stem glabrous, several from one root, 150 mm. high; stipules large laciniate, leaves cordate-ovate, crenate, 30 x 35 mm., glabrous; petioles 20 mm. long, numerous smaller glabrous radical leaves. Flowers creamy-white, 15–20 mm. broad, lower and lateral petals lined with purplish-black, the former well bearded near the base; stipules linear-lanceolate; pedicels 50–60 mm. long.

Fruiting plants are 300 mm. high, with leaves 40 x 40 mm., quite acutely pointed. Some plants produce cleistogamic flowers in the upper axils.

29. *Viola muhlenbergii* Torrey.

Viola canina various American authors (*nec* European authors).

Viola uliginosa Muhlenberg, 1813, Catalogue, p. 26 (*nec* Schrader).

Viola muhlenbergii Torrey, 1824, Flora U. S., p. 256.

Viola muhlenbergiana ("Gingins" D. C., 1824, Prodomus, I, p. 297.

Range.—From the highest Alleghanies to Philadelphia; in New Jersey, northern counties south to Freehold, and casually in the lower Delaware valley to Salem (Britton).

Habitat.—Damp woodland, or sometimes open ground.

Description.—Flowering plant, Crum creek, Delaware county, Pennsylvania, April 10, 1903. No. 5,165, Herb., W. S. Stems glabrous, somewhat reclining, 70 mm. long, a number from the same root and with numerous radical leaves; stipules with lacunate margins. Leaves reniform or nearly orbicular, crenate, 15 x 15 mm., lower cauline 18 mm. in length. Flowers pale lilac-purple, lower petals lined with black, laterals slightly bearded; sepals linear-lanceolate. The lowest flower is very long-pedicelled (50 mm.) and overtops the rest of the plant; there is usually one other true flower and often cleistogenes in the upper axils.

Fruiting plant, Crum creek, May 17, 1903. No. 5,166, Herb., W. S. Stems 200 mm. high, leaves 30 x 30 mm. Usually two or three fruiting pedicels and a cleistogene on each stem, each shorter than the one below; radical leaves still persistent.

While this is evidently closely allied to *V. labradorica* Schrank., the fact that Prof. Greene has shown that there are several distinct forms of this species in the northeastern part of the country makes it desirable to retain the present name for our plant. It is almost certainly distinct from the Labrador form, but probably may be regarded as a subspecies of it.

Viola rostrata Pursh is common in the Alleghanies and comes southward to Bucks county. Muhlenberg's name is unrecognizable until clearly defined by Pursh; his specimens, however, show that both writers had the same plant in view.

Viola canadensis Linn. is also abundant in our mountains, and there is a specimen in the Academy herbarium marked Sellersville, Bucks county, the farthest south that I have heard of its occurrence.

30. *Viola rafinesquii* Greene.

"*Viola bicolor*" and "*arvensis*" of several American authors (*nec* European authors).

Viola tenella Muhlenberg, 1813, Catalogue, p. 26 (*nec* Poiret, 1810).

Viola rafinesquii Greene, 1899, Pittonia, IV, p. 9.

Range.—Along the Susquehanna and Delaware rivers, and abundant at various localities in southern New Jersey outside the pine barrens.

Habitat.—Low sandy ground.

Description.—Flowering plants, Nottingham, Chester county, Pennsylvania, near Octoraro creek, May 6, 1902. Benjamin H. Smith. No. 5,171, Herb., W. S. Stems glabrous, 100–150 mm. high, often branching close to the base; stipules conspicuous, deeply cut, lobed; leaves 20 mm., linear-lanceolate or spatulate, the lower nearly orbicular (10 x 10 mm.), contracted into margined petioles, 8–10 mm. in length, obscurely toothed, glabrous. Flowers several in the upper axils on pedicels 25 mm. long, yellowish with a blue tinge, lower petal lined with black, 15–18 mm. wide, sepals rather broadly lanceolate-acute.

Plants in full fruit May 30, same size as above. No further growth takes place, and the plants soon wither up.

NOMENCLATURE AND SYNONYMY.

Difficult as it is to determine the number of distinct forms that exist among our violets, it is a still harder problem to ascertain what names they should be known by. Some 160 specific or varietal names have been proposed for violets of eastern North America, and as many of these are very meagrely described, it is well-nigh impossible to be sure what forms the authors had in hand.

In the preceding pages I have entered in the synonymy only such names as seem without reasonable doubt to refer to the species in question, and have discussed matters of nomenclature only so far as absolutely essential to the determination of the proper name to use in each case. In order, however, to satisfactorily cover the synonymy of the genus, I have prepared a list of the names known to me which have been applied to eastern North American violets—both specific and

subspecific—with some comment upon their status, the type locality and the group to which the name belongs, viz., “A.B.”=Acaulescent blue; “C.Y.”=Caulescent yellow, etc.

Many species recently described by Prof. Greene and Mr. Pollard are listed here which do not occur in the region that I have studied, and I am quite unprepared to discuss their relationship. In order, however, that some idea of their affinities may be obtained, I have given the names of the better known species with which they are compared in the original descriptions.

I have likewise noted in brackets the reference to the *Illustrated Flora* of Britton and Brown for all species recognized in that work. Additional species recognized in Britton's *Manual* have references to that work, and still others which are recognized in the preceding pages are marked accordingly.

The principal works and papers in which North American species are described or in which the genus is reviewed are:

- LINNEÆUS, 1753. *Species Plantarum*.
 WALTER, 1788. *Flora Carolina*.
 AITON, 1789, in *Hortus Kewensis*.
 MICHAUX, 1803. *Flora Boreali-Americana*.
 WILLDENOW, 1806. *Hortus Beroliensis*.
 MUHLENBERG, 1813. *Catalogue*.
 PURSH, 1814. *Flora Americana Septentrionale*.
 SMITH, 1817, in *Rees' Cyclopædia*.
 ELLIOT, 1817. *Botany of South Carolina and Georgia*.
 NUTTALL, 1818. *Genera of N. A. Plants*.
 SCHWEINITZ, 1822, in *American Journal of Science*, V.
 DECANDOLLE, 1824. *Prodromus*, I.
 LE CONTE, 1828. *Annals Lyceum N. Y.*, II.
 DON, 1831. *General System*.
 GRAY, 1886. *Botanical Gazette*, XI, pp. 253–256 and 289–293.
 POLLARD, 1896. *Proc. Biological Soc. Wash.*, X, pp. 85–92.
 POLLARD, 1898. *Botanical Gazette*, XXVI, pp. 325–342.
 POLLARD, 1901, in *Britton's Manual*.
 GREENE, 1896–1903. Various articles in *Pittonia*.

- acuta* “Bigelow” Torrey. 1824. *Flora U. S.*, I, p. 253.
 (A.W.) Proposed as a variety of and allied to *lanceolata*, if not identical. Cambridge, Mass.
affinis Le Conte. 1828. *Ann. Lyc. N. Y.*, II, p. 138. [Britt. *Manual*, No. 9.]
 (A.B.)
alabamensis Pollard. 1900. *Proc. Biol. Soc. Wash.*, p. 169.
 (A.B.) Allied to *villosa* and *carolina*.

alba Thurber?

(A.B.) A mere white form of *pedata*, of which it is styled a variety.

albiflora Don. 1831. Gen. Syst., I, p. 320.

(A.B.) A mere white form of *septemloba* Le Conte.

albiflora Don. 1831. Gen. Syst., I, p. 321.

(A.B.) A similar variant of "*heterophylla* Muhl." Other albinos have also been so named.

allegahaniensis Roem and Schult. Syst., 5, p. 560.

() Quoted by DeCandolle. I have been unable to verify it.

alsophila Greene. 1899. Pittonia, IV, p. 7.

(A.W.) New name for *amæna* Le C. See *leconteana* Don.

amæna Le Conte. 1828. Ann. Lyc. N. Y., II, p. 144.

(A.W.) Antedated by *amæna* Symons, 1798, Syn. Pl. Brit., p. 198. See *leconteana*.

amorphophylla Pollard. 1900. Proc. Biol. Soc. Wash., p. 129.

(A.B.) Related to *sagittata*. Tryon, N. Carolina.

angellæ Pollard. 1902. Torrey, II, No. 2, p. 24. [*antea*, p. 678.]

(A.B.) Orange, New Jersey.

arenaria D. C. 1805. Flor. France, IV, p. 806. [Ill. Flor., 2,508.]

(C.B.) A European species credited to North America.

arvensis.

(C.B.) A European species found also in North America.

asarifolia Muhlenberg. 1813. Cat., p. 26.

(C.B.) Not recognizable [specimens = *muhlenbergii*].

asarifolia Pursh. 1814. Flor. Amer. Sept. Suppl., p. 732.

(A.B.) Antedated by *asarifolia* Muhl., 1813., Virginia to Carolina.

atlantica Britton. 1897. Bull. Torrey Bot. Club., XXIV, p. 92.

(A.B.) Antedated by *atlantica* Pomel, 1874. See *brittoniana* Pollard. East Massachusetts to south New Jersey.

atropurpurea "Raf." D.C. 1824. Prodr., I, p. 291.

(A.B.) Proposed as a variety of *pedata*, and a pure synonym of true *pedata*.

attenuata "Sweet" Don. 1831. Gen. Syst., I, p. 322.

(A.W.) Proposed for *lanceolata* Pursh, which he regards as different from *lanceolata* Linn. The name does not occur in Sweet Hort. Brit., 1826, p. 37, to which reference is made.

australis Pollard. 1898. Bot. Gazette, XXVI, p. 342.

(A.W.) Proposed as a race of *primulæfolia*. Duval county, Florida.

barbata Muhlenberg. 1813. Cat., p. 26.

(A.B.) Unrecognizable.

barbata "Willd." D. C. 1824. Prodr., I, p. 292.

(A.B.) *Nomen nudum* in synonymy under *papilionacea*.

belvisiana D. C. 1824. Prodr., I, p. 294.

(A.B.) As a race of *ovata* "*in mont. editioribus Virginiae*."

bernardi Greene. 1898. Pittonia, III, p. 260. [Britt. Manual, No. 4.]

(A.B.) As a race of *pedatifida*, southern Wisconsin.

- bicolor* Pursh. 1814. Flor. Amer. Sept., I, p. 175.
 (C.W. or B.) Antedated by *bicolor* Hoffman. Fl. Germ., II, p. 170, which Pursh probably intended to quote.
- bicolor* "Pursh," Raf., D. C. 1824. Prodr., I, p. 291.
 (A.B.) As synonym under *pedata atropurpurea* Raf. *nomen nudum*.
- blanda* Willdenow. 1806. Hort. Berolien, Pl. XXIV. [Ill. Flor., 2,497.]
 (A.W.)
- boscii* D. C. 1824. Prodr., I, p. 293.
 (A.W.) As a race of *primulaefolia*, and apparently identical with it. Carolina.
- brainerdii* Greene. 1902. Pittonia, V, p. 89.
 (A.W.) = "Specimens No. 17, Distribution N. A. Violets." Vermont.
- brittoniana* Pollard. 1898. Bot. Gazette, XXVI, p. 332. [Ill. Flor., 2,485.]
 (A.B.) New name for *atlantica* Britton.
- canadensis* Linn. 1753. Sp. Plant., pl. 936. [Ill. Flor., 2,505.]
 (C. W.) Canada.
- canina*.
 (C.B.) A European species credited to North America.
- cardminefolia* Greene, 1901. Pittonia, IV, p. 289.
 (C.B.) Allied to *muhlenbergii*. Aylmer, Quebec.
- carolina* Greene. 1898. Pittonia, III, p. 259.
 (A.B.) Allied to *fimbriatula*. Wilmington, North Carolina.
- ciliata* Muhlenberg. 1813. Cat., 26.
 (A.B.) Not recognizable [his specimens = *villosa*].
- clandestina* Pursh. 1814. Flor. Amer. Sept., I, p. 173.
 (A.Y.) Apparently = *rotundifolia*.
- communis* Pollard. 1898. Bot. Gazette, XXVI, p. 336.
 (A.B.) New name for "*obliqua*" and "*cucullata*" of many recent authors, which are not this form, but not *communis* Wittrock; cf. Greene, Pittonia, IV, p. 140. Apparently = *papilionacea* Pursh.
- congener* Le Conte. 1828. Ann. Lyc. N. Y., II, p. 140.
 (A.B.) = Form of *palmata* (cf. Greene, Pittonia, III, p. 142).
- conjugens* Greene, 1899. Pittonia, IV, p. 3. [Britton's Manual, No. 21.]
 (A.B.) Allied to *emarginata* and *cucullata*. Anne Arundel county, Maryland.
- consors* Greene. 1902. Pittonia, V, p. 100.
 (A.B.) Close to *cucullata*. Prince Edward's Island.
- cordata* Walter. 1788. Flor. Carol., p. 219.
 (A.B.) Not recognizable.
- cordata* D.C. 1824. Prodr., I, p. 293.
 (A.W.) As a race of *primulaefolia*.
- cordifolia* Nuttall. 1818. Gen., I, p. 148. [*antea*, p. 674.]
 (A.B.) = Race of *villosa* Walter. Philadelphia.

- cordiformis* D. C. 1824. Prodr., I, p. 292.
 (A.B.) As a race of *cucullata*. Not distinguishable.
- crassula* Greene. 1902. Pittonia, V, p. 96.
 (A.B.) Allied to *crenulata*. Jackson, Michigan.
- crenulata* Greene. 1901. Pittonia, IV, p. 295. [*antea*, p. 674.]
 (A.B.) Syracuse, New York.
- cucullata* Aiton. 1789. Hort. Kew., III, p. 288. [Ill. Flor., 2,487b.]
 (A.B.) N. A. (from Dr. Samuel Martin).
- cuspidata* Greene, 1898. Pittonia, III, p. 314. [Britt. Manual, No. 8.]
 (A.B.) Allied to *papilionacea*. Wisconsin.
- debilis* Michaux. 1803. Flor. Bor. Amer., II, p. 150.
 (C.B.) Probably = *striata*. "In mont. Alleghanis."
- dentata* Pursh. 1814. Fl. Am. Sept., I, p. 172.
 (A.B.) *sagittata* group, identity doubtful. Pennsylvania.
- denticulosa* Pollard. 1901. Bull. Torrey Bot. Club, XXVIII, p. 475.
 (A.W.) Allied to *lanceolata*. Douglas, Coffee county, Georgia.
- dicksonii* Greene. 1899. Pittonia, IV, p. 65.
 (A.B.) Allied to *cuspidata*. Canadian woods.
- digitata* Pursh. 1814. Fl. Amer. Sept., I, p. 171.
 (A.B.) *palmata* group, identity doubtful. Virginia.
- digitata* Darlington. 1826. Florula Cestrica, p. 29.
 (A.B.) Apparently intended for *digitata* Pursh. West Chester, Pennsylvania.
- dilatata* Elliott. 1817. Bot. S. C. and Ga., I, p. 300. [Britt. Manual, 1a.]
 (A.B.) As a race of *palmata*. Upper districts Georgia and Carolina.
- domestica* Bicknell. 1898. In Britt. and Brown, Ill. Flora, III, p. 519.
 (A.B.) Rich ground form of *papilionacea*. South Pennsylvania and New Jersey.
- elegantula* Greene. 1899. Pittonia, IV, p. 66.
 (A.B.) "Foliage of *blanda*, flowers of *cucullata*." Ottawa, Canada.
- emarginata* Nuttall. 1818. Gen., I, p. 147. [Ill. Flor., app. 2,490a.]
 (A.B.) Philadelphia and adjacent New Jersey.
- eriocarpon* Nuttall. 1818. Gen., I, p. 150.
 (C.Y.) As a race of *pubescens*, from which it cannot be separated. Philadelphia.
- esculenta* Elliot. 1817. Bot. S. C. and Ga., I, p. 300.
 (A.B.) Given as a synonym under "*heterophylla* Muhl.," which is fully described. Ogeechee river.
- eurybiæfolia* Greene. 1902. Pittonia, V, p. 25.
 (C.W.) "Provisional" name for southern race of *V. canadensis* L., on the assumption that Linnæus had the northern form. Sullivan county, New York.
- falcata* Greene. 1899. Pittonia, IV, p. 3. [Britt. Manual, No. 6.]
 (A.B.) *palmata* group. Cobden, Illinois.
- fimbriatula* Smith. 1817. Rees' Cyclop., XXXVIII. [= Ill. Flor., 2,491.]
 (A.B.) A new name for *primulæfolia* Pursh (*nec* Linn.).

flabellifolia Loddiger. Bot. Cab., 777.

(A.B.) Quoted by Don, 1831. Apparently another name for *V. pedata* *bicolor* Pursh, though I have been unable to refer to it.

fletcheri Greene. 1901. Pittonia, IV, p. 296.

(A.B.) Allied to *papilionacea*. Ottawa, Ontario.

fragrans Elliot. 1817. Bot. of S. C. and Ga.

(A.B.) As a variety of *palmata*. Near Savannah, Georgia.

gibbosa "Raf." D. C. 1824. Prodr., I, p. 305.

(C.Y.) Possibly identical with *scabriuscula*. Alleghany Mountains.

glaberrima D. C. 1824. Prodr., I, p. 292.

(A.B.) Proposed as a variety of *cucullata* Ell., and intended as a new name for *cucullata* Ait., which is considered subspecifically different.

glaberrima Don. 1831. Gen. Synop., I, p. 329.

(C.Y.) As a variety of *hastata*, antedated by preceding.

hastata Michaux. 1803. Flor. Bor. Amer., II, p. 149. [Ill. Flor., 2,502.]

(C.Y.) High mountains of Carolina.

heterophylla Muhlenberg. 1813. Cat., p. 25.

(A.B.) Antedated by *heterophylla* Poiret and *heterophylla* Bertol.

hicksii Pollard. 1895. Botan. Gazette, XX, p. 326.

(A.B.) As a race of *sagittata*, and afterward referred to *ovata* as a subspecies. Rock Creek Park, District of Columbia.

hispidula D. C. 1824. Prodr., I, p. 292.

(A.B.) Proposed as a race of *cucullata*, not recognizable.

illinoensis Greene. 1901. Pittonia, IV, p. 293.

(A.B.) Somewhat allied to *affinis*. Monticello, Illinois.

inornata Greene. 1896. Pittonia, III, p. 35.

(A.B.) New name for "*V. pedata* Curtis, Bot. Mag., t. 89," *nec pedata* Linn., which is the bicolored form. See *lineariloba*.

insignis Pollard. 1898. Bot. Gazette, XXVI, p. 334.

(A.B.) Jacksonville, Florida. Name antedated by *insignis* Richter, 1888.

labradorica Schrank. 1818. Denksch. bot. Gesell. Regensb., II, p. 12.

(C.B.) I have not been able to consult this reference. The plant is probably distinct from *muhlenbergii*.

latecærulea Greene. 1901. Proc. Biol. Soc. Wash., p. 70.

(A.B.) Allied to *papilionacea*. Potomac Flats, District of Columbia.

lanceolata Linn. 1753. Sp. Plant., pl. 953. [Ill. Flor., 2,500.]

(A.W.) "Canada."

latiuscula Greene. 1902. Pittonia, V, p. 93.

(A.B.) Allied to *affinis*. Twin Mountain, West Rutland, Vermont.

leconteana Don. 1831. Gen. Syst., I, p. 324. [= Ill. Flor., var. *amæna*, under 2,497.]

(A.W.) New name for *amæna* Le Conte.

- leptosepala* Greene. 1902. Pittonia, V, p. 98. [*antea*, p. 674.]
 (A.B.) A race of *cucullata*. Oakland, Maryland.
- lewisiana* "Gingins" Don. 1824. Prodr., I, p. 298.
 (C.W.) New name for *repens* Schw.
- lineariloba* D. C. 1824. Prodr., I, p. 291. [*antea*, p. 681.]
 (A.B.) Proposed as a variety of *pedata*, and based on Pl. 89 of Curtis Bot. Mag.
- macounii* Greene. 1898. Pittonia, III, p. 335.
 (A.B.) "Very different from all other N. A. species." Ottawa and Quebec.
- macrotis* Greene. 1902. Pittonia, V, p. 97. [*antea*, p. 673.]
 (A.B.) A race of *cucullata*. Surrallsville, Maryland, and Berlin, New Jersey.
- melissæfolia* Greene. 1903. Pittonia, V, p. 103.
 (A.B.) "Allied to *nesiotica*." Prince Edward's Island.
- mistassinica* Greene. 1899. Pittonia, IV, p. 5.
 (A.W.) One of *blanda* group. Labrador.
- muhlenbergii* Torrey. 1824. Flor. U. S., I, p. 256. [Ill. Flor., 2,507.]
 (C.B.) New name for *uliginosa* Muhl. (*nec* Schrader) and *debilis* Schw. (*nec* Michx.). Cedar swamp, New Durham, New Jersey.
- muhlenbergiana* "Gingins" D. C. 1824. Prodr., I, p. 297.
 (C.B.) New name for *uliginosa* Muhl. (*nec* Schrader). Pennsylvania. Possibly antedates the preceding.
- mulfordæ* Pollard. 1902. Proc. Biol. Soc. Wash., p. 203.
 (A.B.) Allied to *brittoniana*. Hempstead Plains, Long Island.
- multicaulis* Torrey and Gray. 1838. Flora, I, p. 140. [Ill. Flor., 2,509.]
 (C.B.) Allied to *muhlenbergii*.
- multifida* Mill. 1768. Dict., 8 ed.
 (A.B.) = *pedata* Linn., *vid* Greene, Pittonia, III, p. 35.
- nepetæfolia* Greene. 1902. Pittonia, V, p. 93.
 (A.B.) Allied to *affinis*. Some of No. 20 Dist. of N. A. violets are this. Washington, District of Columbia.
- nesiotica* Greene, 1902. Pittonia, V, p. 102.
 (A.B.) "Closely allied to *subviscosa*." Prince Edward's Island.
- nodosa* Greene. 1901. Pittonia, IV, p. 296.
 (A.B.) Related to *cuspidata*. Syracuse, New York.
- nuttallii* Pursh. 1814. Flor. Amer. Sept., I, p. 174. [Ill. Flor., 2,501.]
 (C.Y.) Missouri river.
- nuttallii* Don. 1831. Gen. Syst., I, p. 324.
 (A.B.) Proposed as a variety of *sororia*, and intended as a new name for *V. villosa cordifolia* Nutt., antedated by *nuttallii* Pursh, 1814.
- obliqua* Hill. 1769. Hort. Kew., p. 316, t. 12.
 (A.B.) Not identifiable.
- ochroleuca* Schweinitz. 1822. Amer. Jour. Sci., V, p. 69.
 (C.W.) = *striata* Aiton. Dan river toward Saura Mountains.
- odorata* Linnæus. 1753. Sp. Plan., pl. 934. [Ill. Flor., 2,493.]
 (A.B.) A European species introduced into North America.

ovata Nuttall. 1818. Gen., I, p. 148.

(A.B.) A new name for *primulæfolia* Pursh (*nec* Linn.). Philadelphia.

ovata "Raf." D. C. 1824. Prodr., I, p. 293.

(A.W.) Proposed as a race of *primulæfolia*. Pennsylvania.

pallens D. C. 1824. Prodr., I, p. 295.

(A.Y.?) Proposed as a race of *rotundifolia*, unrecognizable. Labrador.

palmata Linnæus. 1753. Sp. Plant., pl. 933. [Ill. Flor., 2,484.]

(A.B.) Virginia.

palustriformis Gray. 1886. Botan. Gazette, XI, p. 255.

(A.W.) Allied to *blanda*.

palustris Linnæus. 1753. Sp. Plant., pl. 934. [Ill. Flor., 2,495.]

(A.B.) A European species attributed to America.

papilionacea Pursh. 1814. Flor. Am. Sept., I, p. 173. [Ill. Flor., 2,487.]

(A.B.) Philadelphia.

pedata Linnæus. 1753. Sp. Plant., p. 933. [Ill. Flor., 2,492.]

(A.B.) Virginia.

pedatifida Don. 1831. Gen. Syst., I, p. 320. [Ill. Flor., 2,486.]

(A.B.) North America.

pennsylvanica Michaux. 1803. Flor. Bor. Amer., II, p. 149.

(C.Y.) = *pubescens* Ait. Schuylkill river, Pennsylvania.

pennsylvanica D. C. 1824. Prodr., I, p. 294.

(A.B.) As a race of *palustris*, unrecognizable.

populifolia Greene. 1898. Pittonia, III, p. 337.

(A.B.) Allied to *cuspidata*. Pt. Flamboro, Ontario.

porteriana Pollard. 1897. Bull. Torrey Bot. Club, XXIV, p. 404. [= Britt. Manual, No. 19.]

(A.B.) A member of the *sagittata* group. Bushkill Falls, Pennsylvania.

pratincola Greene. 1899. Pittonia, IV, p. 65. [Britt. Manual, No. 11.]

(A.B.) Allied to *papilionacea*. Windom, Minnesota.

primulæfolia Linn. 1753. Sp. Plant., pl. 934. [Ill. Flor., 2,499.]

(A.W.) Siberia and Virginia.

primulæfolia Pursh. 1814. Flor. Am. Sept., I, p. 173.

(A.B.) = *fimbriatula* Smith.

priosepala Greene. 1902. Pittonia, V, p. 99.

(A.B.) A race of *cucullata*. Vermont and Quebec.

puberula S. Watson. 1890. Gray's Manual (ed. VI), p. 81.

(C.B.) As a race of *muhlenbergii*. Lakes Huron and Superior.

pubescens Aiton. 1789. Hort. Kew., III, p. 290. [Ill. Flor., 2,503.]

(C.Y.) N. A. (from William Young).

punctata Schw. 1822. Am. Jour. Sci., V, p. 67.

(C.B.) Probably = *labradorica* Schrank. Labrador.

pygmæa "Donn" Muhlenberg. 1813. Cat., p. 26.

(A.W.?) Unrecognizable.

radicans D. C. 1824. Prodr., I, p. 297.

(C.W.) Possibly = *muhlenbergii* or *striata*. South Carolina.

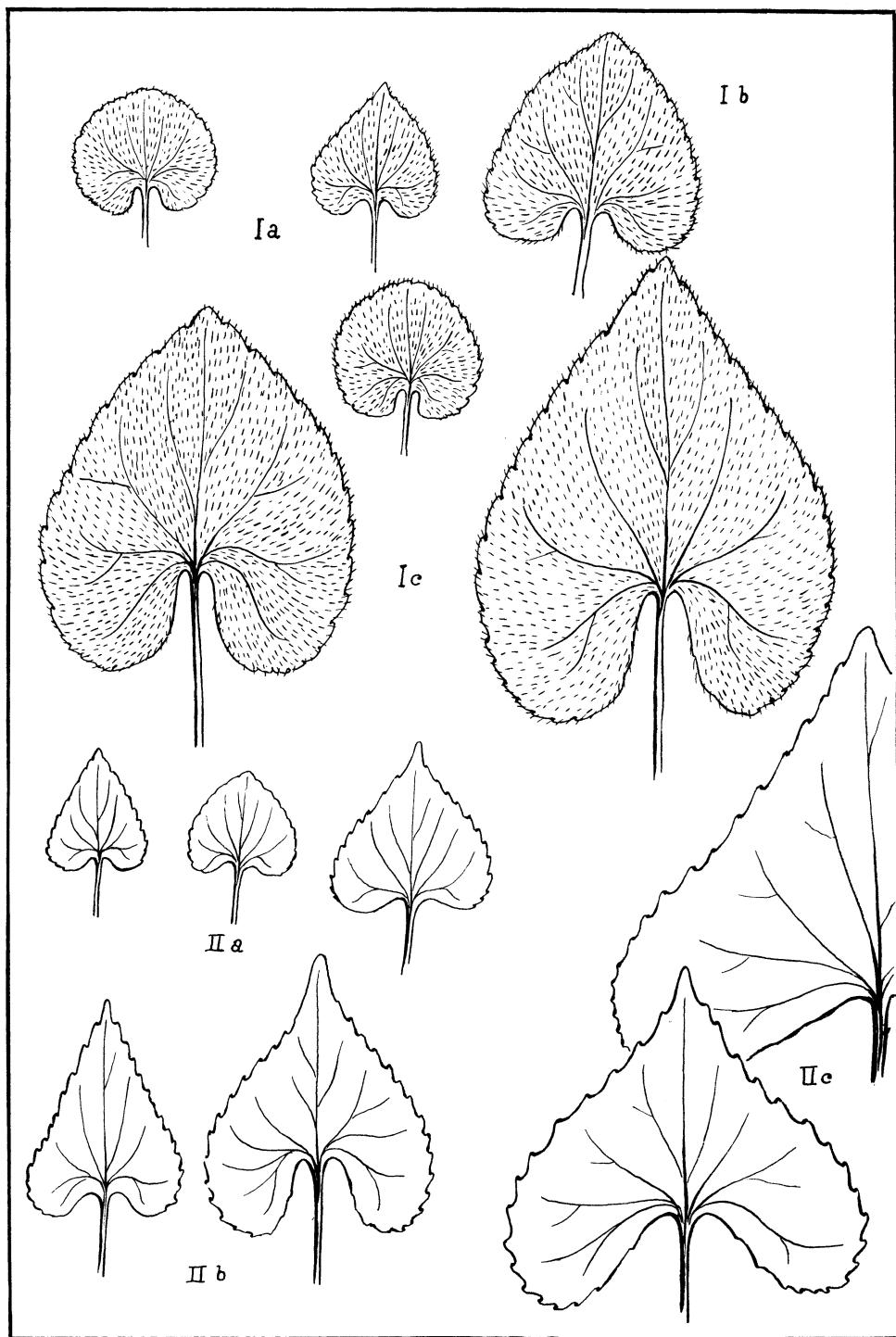
- rafinesquii* Greene. 1899. Pittonia, IV, p. 9. [Ill. Flor., 2,512.]
 (C.W. and B.) New name for *V. tenella* Muhl., which is a *nomen nudum*, and is antedated by *V. tenella* Poiret, 1810.
- ranunculifolia* "Gingins" D. C. 1824. Prodr., I, p. 291.
 (A.B.) Proposed as a variety of *pedata*, but unrecognizable; reference is also made: "*ranunculifolia* Poir.! dict. 8, p. 626?"
- renifolia* Gray. 1870. Proc. Amer. Acad., VIII, p. 288. [Ill. Flor., 2,498.]
 (A.W.) East Elba, New York.
- repens* Schweinitz. 1822. Amer. Jour. Sci., V, p. 70.
 (C.W.) Allied to *striata*. Rocks of Saura Mountains.
- rostrata* Muhlenberg. 1813. Cat., p. 26. [Ill. Flor., 2,510.]
 (C.B.) Unrecognizable, until described by Pursh, 1814, Flor. Am. Sept., I, p. 174. Easttown [= Easton], Pennsylvania.
- rotundifolia* Michaux. 1803. Flor. Bor. Amer., II, p. 150. [Ill. Flor., 2,494.]
 (A.Y.) High Mountains, Carolina.
- sagittata* Aiton. 1789. Hort. Kew., III, p. 287. [Ill. Flor., 2,490.]
 (A.B.) Pennsylvania (from Dr. John Fothergill).
- sagittata* Pursh. 1814. Flor. Am. Sept., I, p. 172.
 (A.B.) Antedated by the above and probably = *fimbriatula*.
- scabriuscula* Schweinitz. 1822. Amer. Jour. Sci., V, p. 75. [Ill. Flor., 2,504.]
 (C.Y.) Salem, North Carolina.
- selkirkii* "Pursh," Goldie. 1822. Edinb. Phil. Mag., VI, p. 324. [Ill. Flor., 2,496.]
 (A.B.) Mountains about Montreal.
- septemloba* Le Conte. 1828. Ann. Lyc. N. Y., II, p. 141. [*antea*, p. 678.]
 (A.B.) Pine woods, Carolina and Georgia.
- septentrionalis* Greene. 1898. Pittonia, III, p. 334. [Britt. Manual, 14.]
 (A.B.) Allied to *cuspidata*. Ottawa.
- sororia* Willdenow. 1806. Hort. Berol., Pl. LXXII.
 (A.B.) Application somewhat doubtful, probably = *dilatata*. North America.
- striata* Aiton. 1789. Hort. Kew., III, p. 290. [Ill. Flor., 2,506.]
 (C.W.) N. A. (from William Young).
- striata* Schweinitz. 1822. Am. Jour. Sci., V, p. 76.
 (C.Y.) Allied to *hastata*, but name antedated by the last.
- striata* Willis. 1874. Catalogue Plants of N. J.
 (A.B.) As a race of *cucullata*, from which it does not seem separable.
- subsagittata* Greene. 1898. Pittonia, III, p. 315.
 (A.B.) Allied to *sagittata*. West of Lake Michigan.
- subsinnuata* Greene. 1898. Pittonia, III, p. 313.
 (A.B.) As a race of *emarginata*. Mountains, East Tennessee.
- subvestita* Greene. 1897. Erythraea, VI, p. 39.

- subviscosa* Greene. 1901. Pittonia, IV, p. 293.
 (A.B.) Allied to *septentrionalis*. Prince Edward's Island.
- tenella* Muhlenberg. 1813. Cat., p. 26.
 (C.B. and W.) *Nomen nudum* and antedated by *tenella* Poiret, 1810, in Lam. dict., n. 53 = *rafinesquii*.
- tenuipes* Pollard. 1902. Proc. Biol. Soc. Wash., p. 201.
 (C.Y.) Allied to *hastata*. Chattahoochee, Florida.
- thompsonæ* Chapman. 1897. Flor. So. States (Ed. III).
 (A.B.) = *odorata* Linn.
- tricolor* Linnæus. 1753. Sp. Plant., pl. 935. [Ill. Flor., 2,511.]
 (C.B.) A European species, introduced.
- triloba* Schweinitz. 1822. Am. Jour. Sci., V, p. 57.
 (A.B.) Probably = *dilatata*.
- tripartita* Elliot. 1817. Bot. S. Car. and Ga., I, p. 302.
 (C.Y.) A race of *hastata*. Athens, Georgia.
- uliginosa* Muhlenberg. 1813. Cat., p. 26.
 (C.B.) As synonym under *asarifolia*, antedated by *uliginosa* Schrad.
- vagula* Greene. 1899. Pittonia, IV, p. 67. [Britt. Manual, No. 16.]
 (A.B.) Allied to *venustula* and *cucullata*. Ottawa.
- variabilis* Greene. 1902. Pittonia, V, p. 91.
 (A.B.) Harper's Ferry, Virginia.
- variegata* "Donn" Muhlenberg. 1813. Cat., p. 26.
 (A.B.?) Unrecognizable.
- velutina* Schweinitz. 1822. Amer. Jour. Sci., V, p.
 So quoted by some authors, but not to be found in Schweinitz's paper.
- venustula* Greene. 1898. Pittonia, III, p. 335. [Britt. Manual, 15.]
 (A.B.) Allied to *cucullata*. Ottawa.
- vicinalis* Greene. 1899. Pittonia, IV, p. 9.
 (A.B.) New name for *insignis* Pollard (*nec* Richter, 1888).
- viarum* Pollard. 1901. Britton's Manual, p. 635, No. 5.
 (A.B.) Allied to *bernardi*. Valley Park, Missouri.
- villosa* Walter. 1788. Flor. Carol., p. 219. [Ill. Flor., 2,488.]
 (A.B.) More fully described by Elliot, 1817. South Carolina.
- vittata* Greene. 1898. Pittonia, III, p. 258.
 (A.W.) A southern ally of *lanceolata*. Florida.
- vulgaris* Elliot. 1817. Bot. S. Car. and Ga., I, p. 300.
 (A.B.) As a variety of *palmata*.
- watsoni* Greene. 1899. Pittonia, IV, p. 5.
 (A.W.) One of the *blanda* group. Prince Edward's Island.

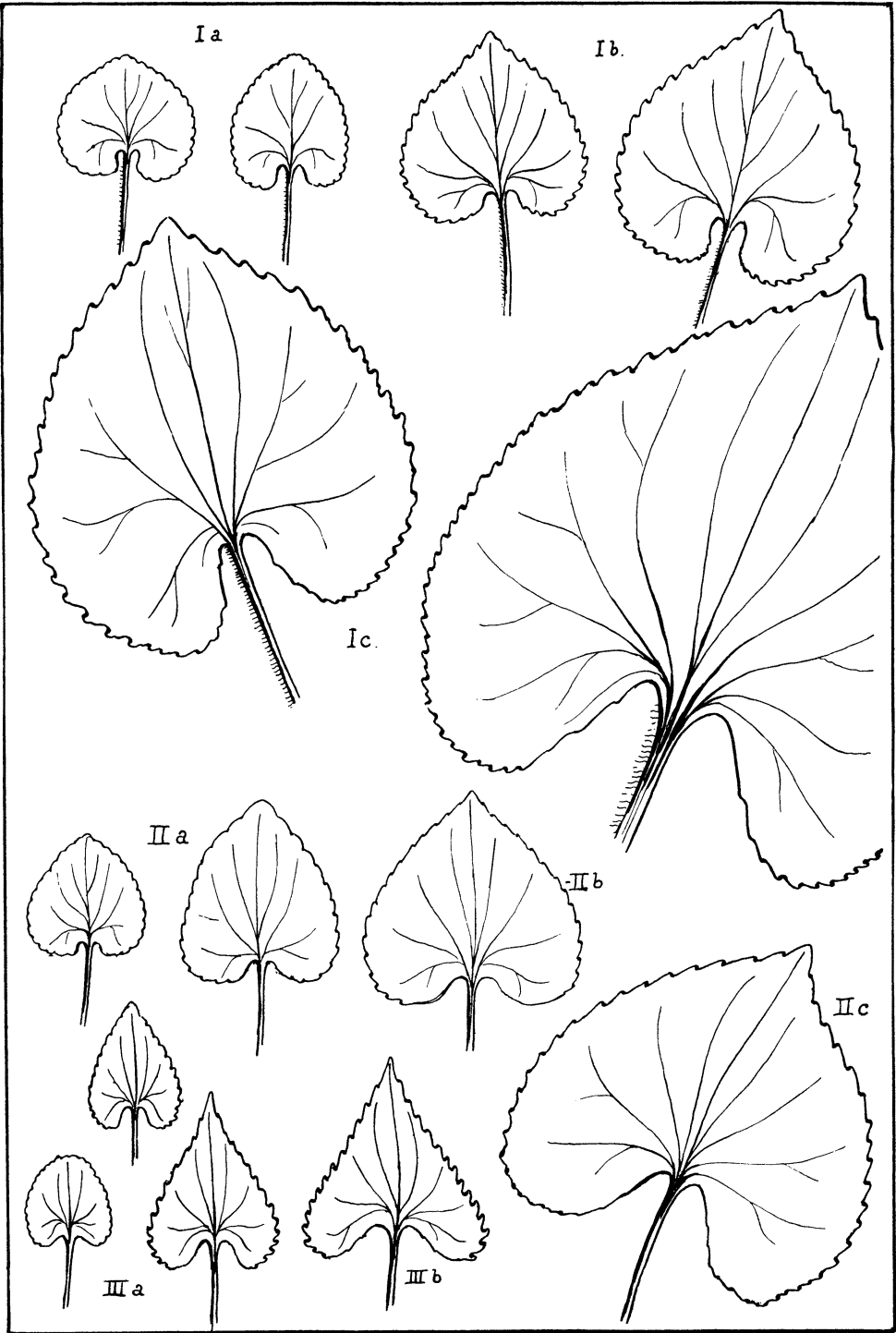
EXPLANATION OF PLATES XXXI-XXXIX.²

- PLATE XXXI, Fig. i.—*Viola villosa cordifolia*.—*a*. Three leaves from early flowering plants. *b*. Leaf from older plant. *c*. Two leaves from fruiting plants.
 Fig. ii.—*Viola affinis*.—*a*. Three leaves from early flowering plants. *b*. Two older leaves. *c*. Two leaves from fruiting plants.
- PLATE XXXII, Fig. i.—*Viola papilionacea*.—*a*. Two early leaves. *b*. Two later leaves. *c*. Two leaves from fruiting plant.
 Fig. ii.—*Viola cucullata*.—*a*. Two early leaves. *b*. Later leaf. *c*. Leaf from plant in fruit.
 Fig. iii.—*Viola crenulata*.—*a*. Three leaves from flowering plant. *b*. Leaf from fruiting plant.
- PLATE XXXIII.—*Viola palmata dilatata*.—1-2. Early leaves. 3-7. Older leaves from flowering plants. 8-13. From fruiting plants.
- PLATE XXXIV, Fig. i.—*Viola palmata*.—*a*. Early leaf. *b*. Later leaf. *c*. From fruiting plant. *d*. Late summer leaf.
 Fig. ii.—*Viola palmata angellæ*.—*a*. Early leaf. *b*. Three leaves from fruiting plant.
- PLATE XXXV, Fig. i.—*Viola brittoniana*.—*a*. Three early leaves. *b*. Two older leaves. *c*. Two leaves from fruiting plant.
 Fig. ii.—*Viola septemloba*.—*a*. Three early leaves. *b*. Older leaf. *c*. Two leaves from plant in fruit.
- PLATE XXXVI, Fig. i.—*Viola sagittata*, Tinicum, Delaware county, Pennsylvania.—*a*. Three early leaves. *b*. Two later leaves. *c*. Three leaves from plants in fruit.
 Fig. ii.—*Viola sagittata*, broader-leaved plant, Tinicum, Delaware county, Pennsylvania.—*a*. Early leaf. *b*. From fruiting plant.
 Fig. iii.—*Viola sagittata* (approaching *emarginata*?), Haddonfield, New Jersey.—*a*. Early leaf. *b*. From fruiting plant.
 Fig. iv.—*Viola emarginata*.—*a*. Three early leaves. *b*. Two leaves from fruiting plants.
 Fig. v.—*Viola emarginata*.—Four leaves from late summer plants.
- PLATE XXXVII, Fig. i.—*Viola fimbriatula*.—*a*. Two early leaves. *b*. Three older leaves. *c*. Leaf from fruiting plant.
 Fig. ii.—*Viola fimbriatula*.—From fruiting plant.
 Fig. iii.—*Viola fimbriatula*.—Exceptionally long petioled slender leaf.
 Fig. iv.—*Viola fimbriatula annectens*.—*a*. Early leaf. *b*. Fruiting leaf.
 Fig. v.—*Viola fimbriatula annectens*.—From fruiting plant.
 Fig. vi.—*Viola fimbriatula annectens*?.—Early leaf.
- PLATE XXXVIII, Fig. i.—*Viola sagittata*.
 Fig. ii.—*Viola emarginata*.
 Fig. iii.—*Viola papilionacea*.
 Fig. iv.—*Viola cucullata*.
 Fig. v.—*Viola fimbriatula*.
- PLATE XXXIX, Fig. i.—*Viola palmata*.
 Fig. ii.—*Viola brittoniana*.
 Fig. iii.—*Viola septemloba*.
 Figs. iv and v.—*Viola palmata dilatata*.

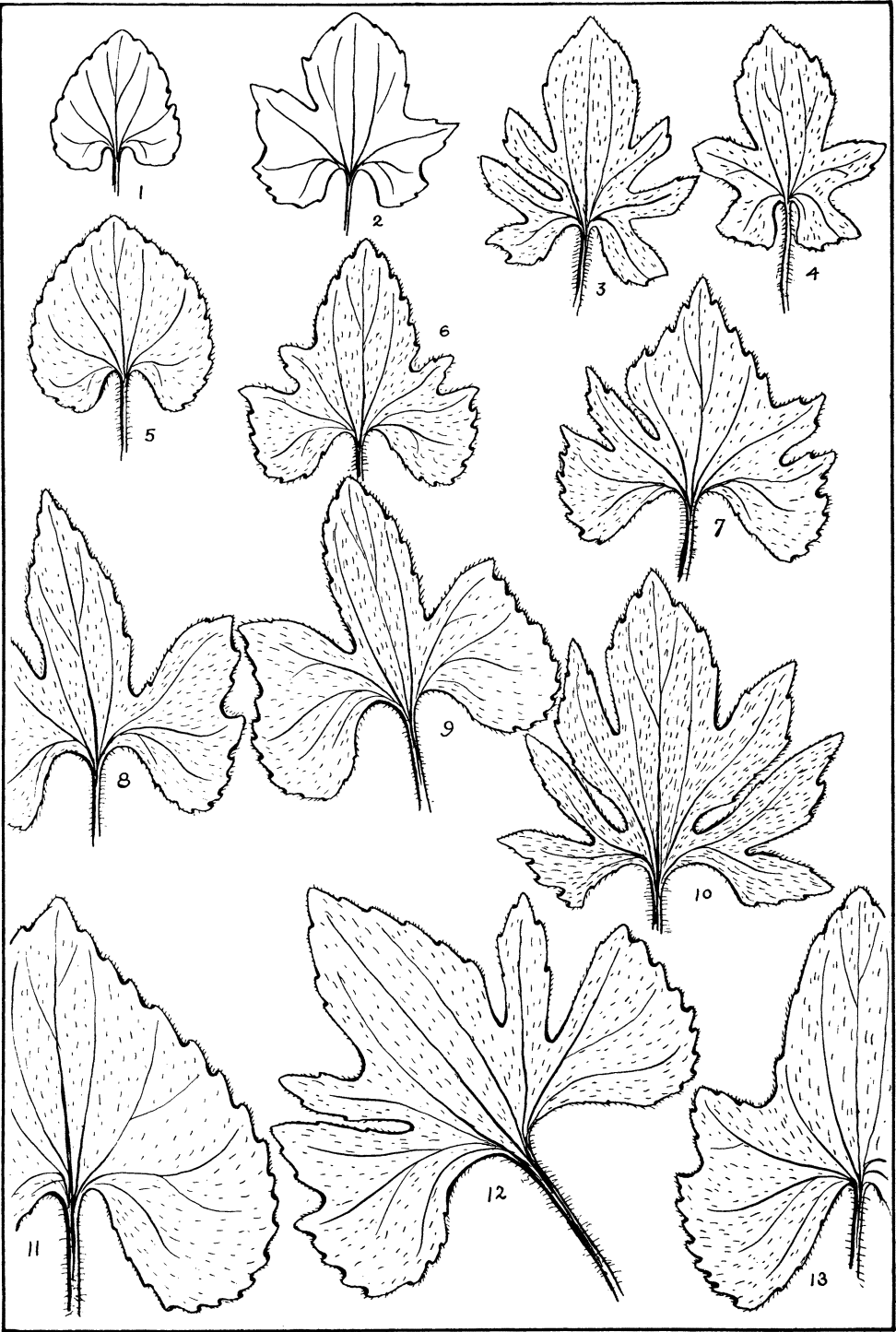
² The drawings represent leaves that have been pressed flat, and no attempt has been made to denote cucullation.



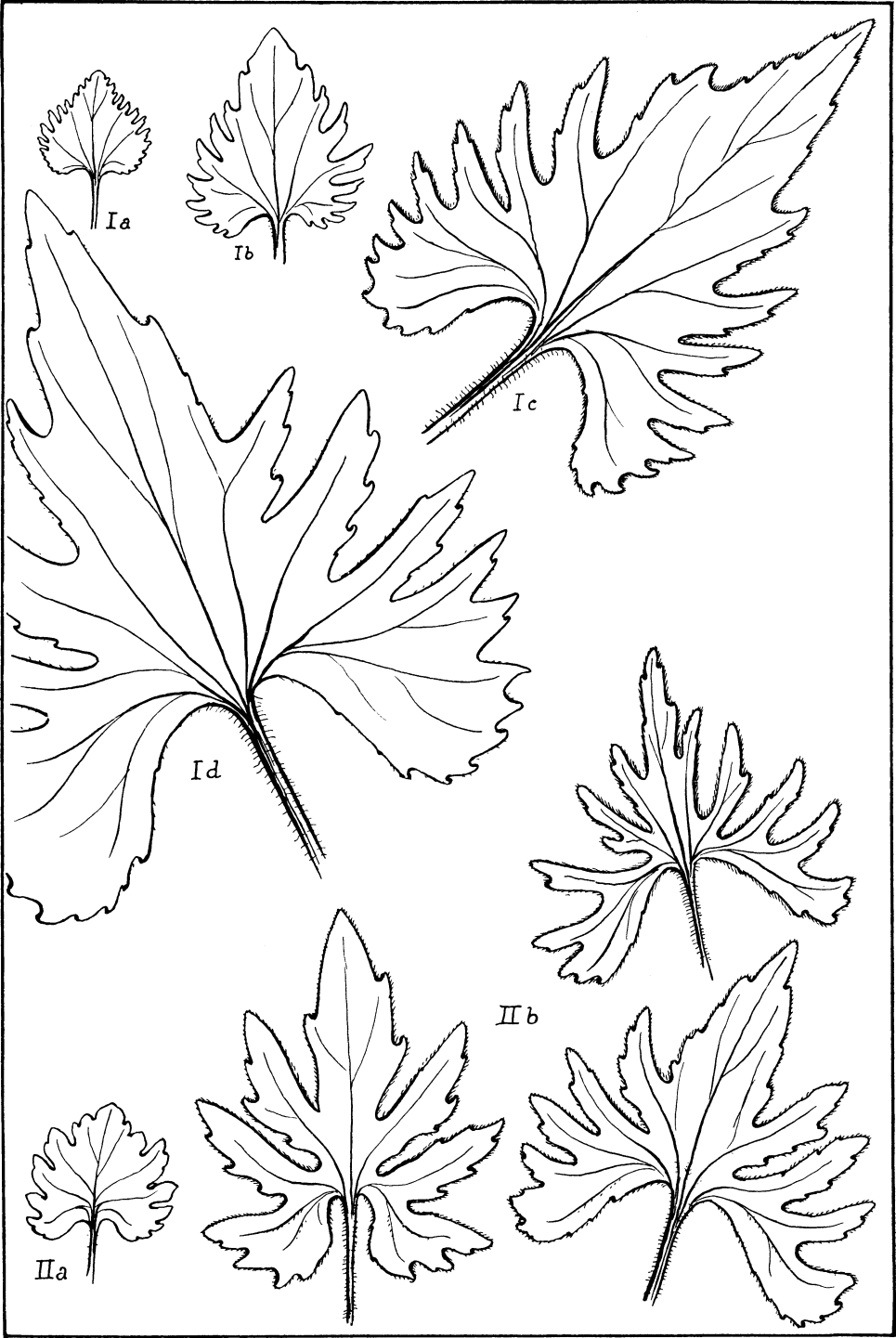
STONE. VARIATION IN VIOLETS.



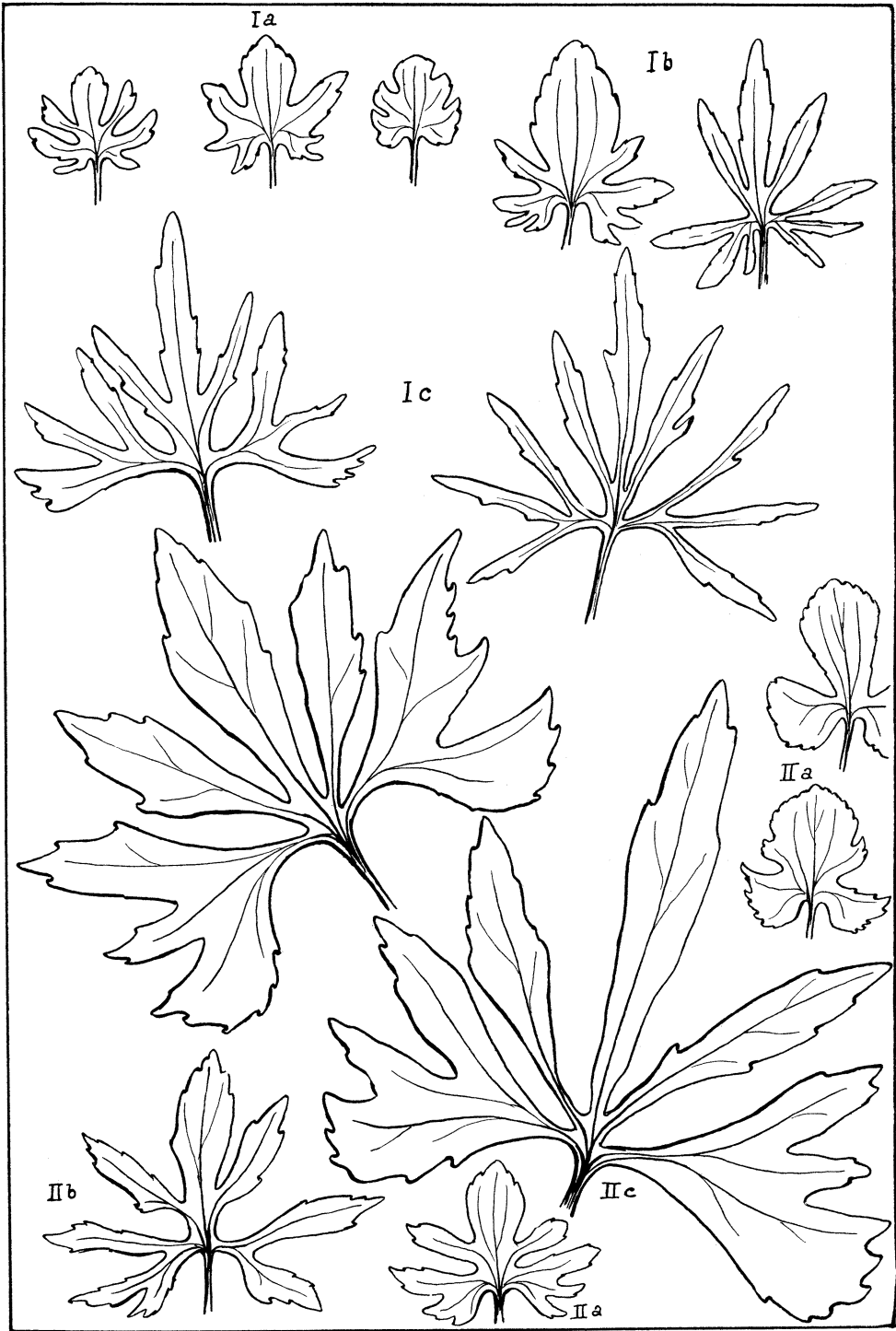
STONE. VARIATION IN VIOLETS.



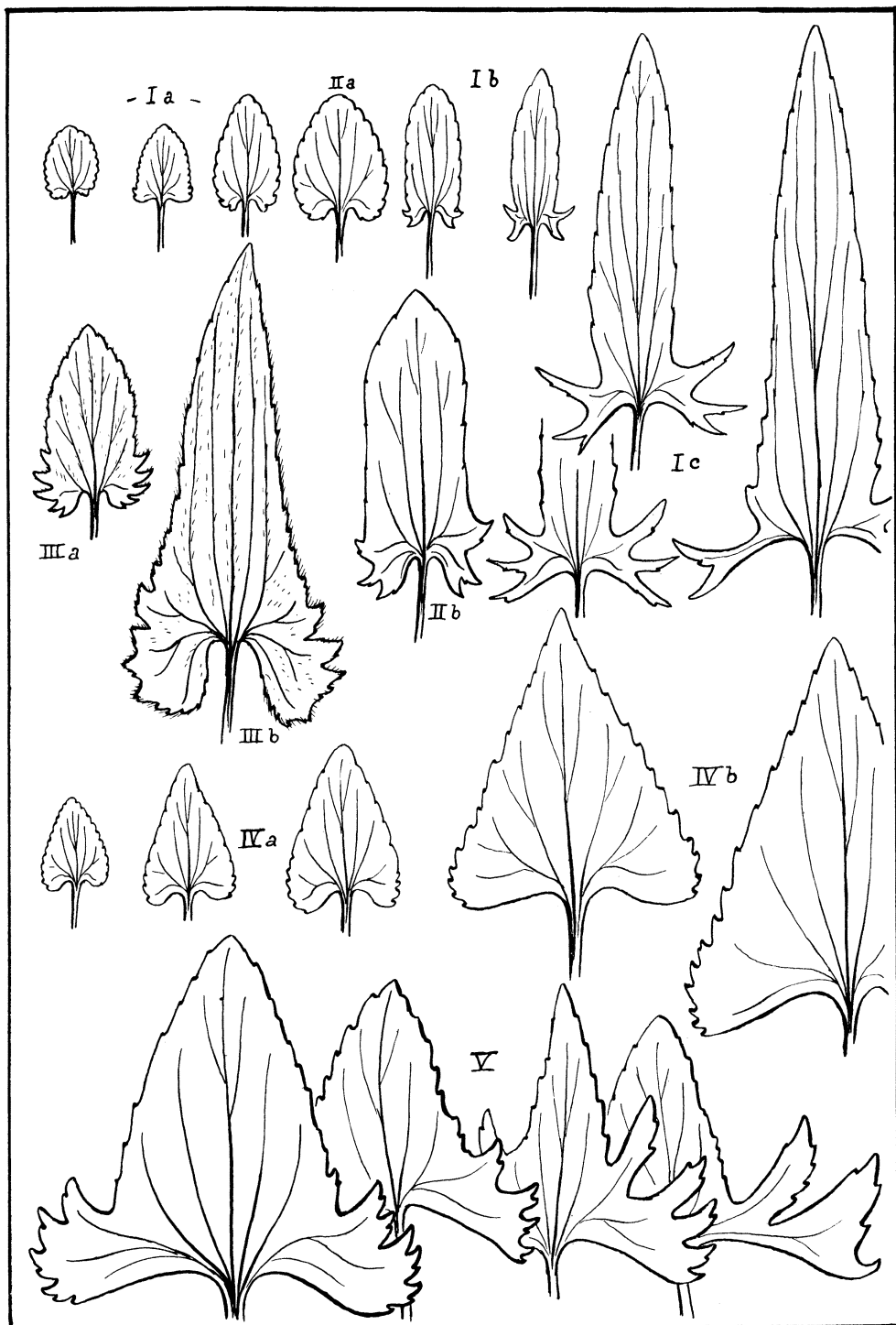
STONE. VARIATION IN VIOLETS.



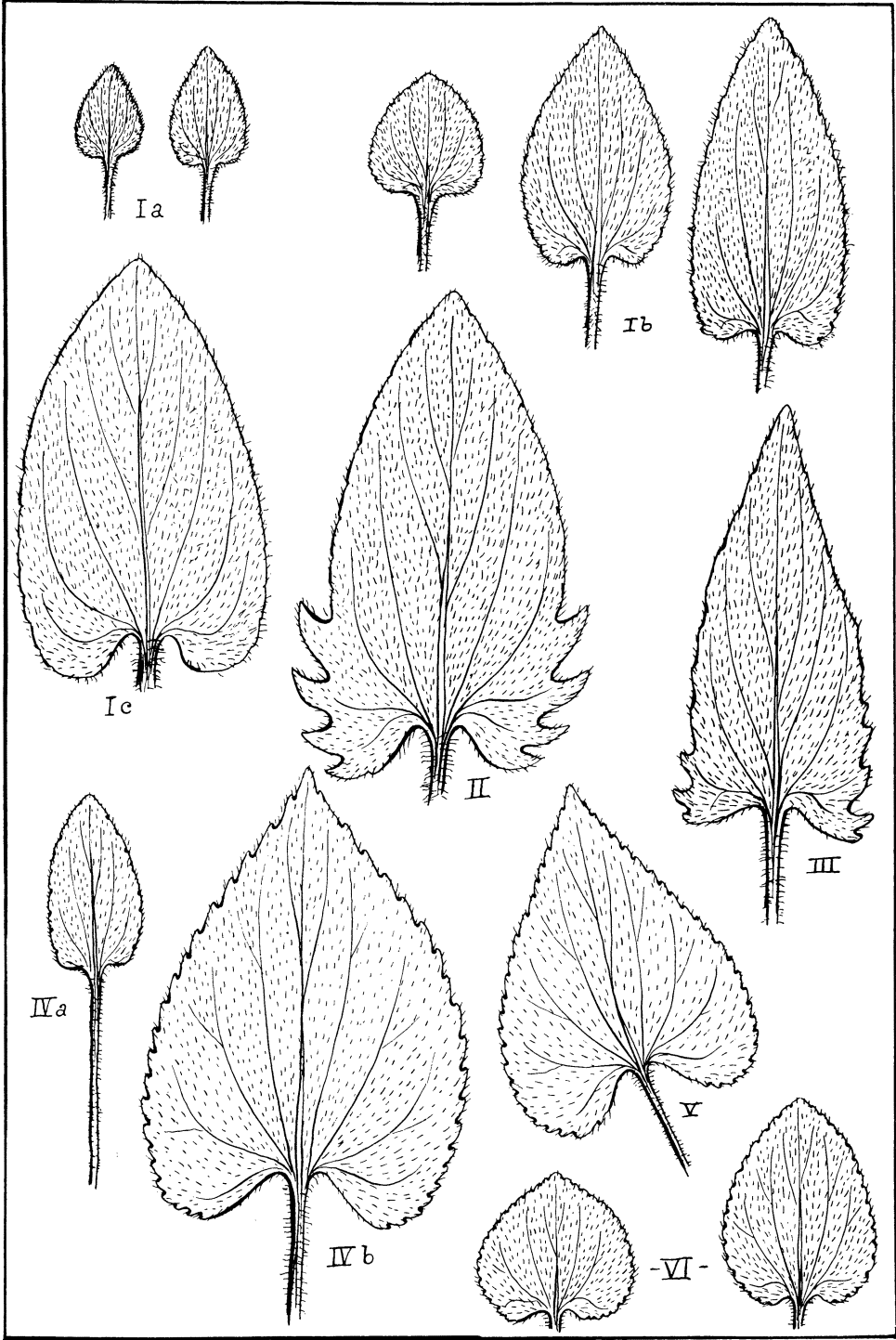
STONE. VARIATION IN VIOLETS.



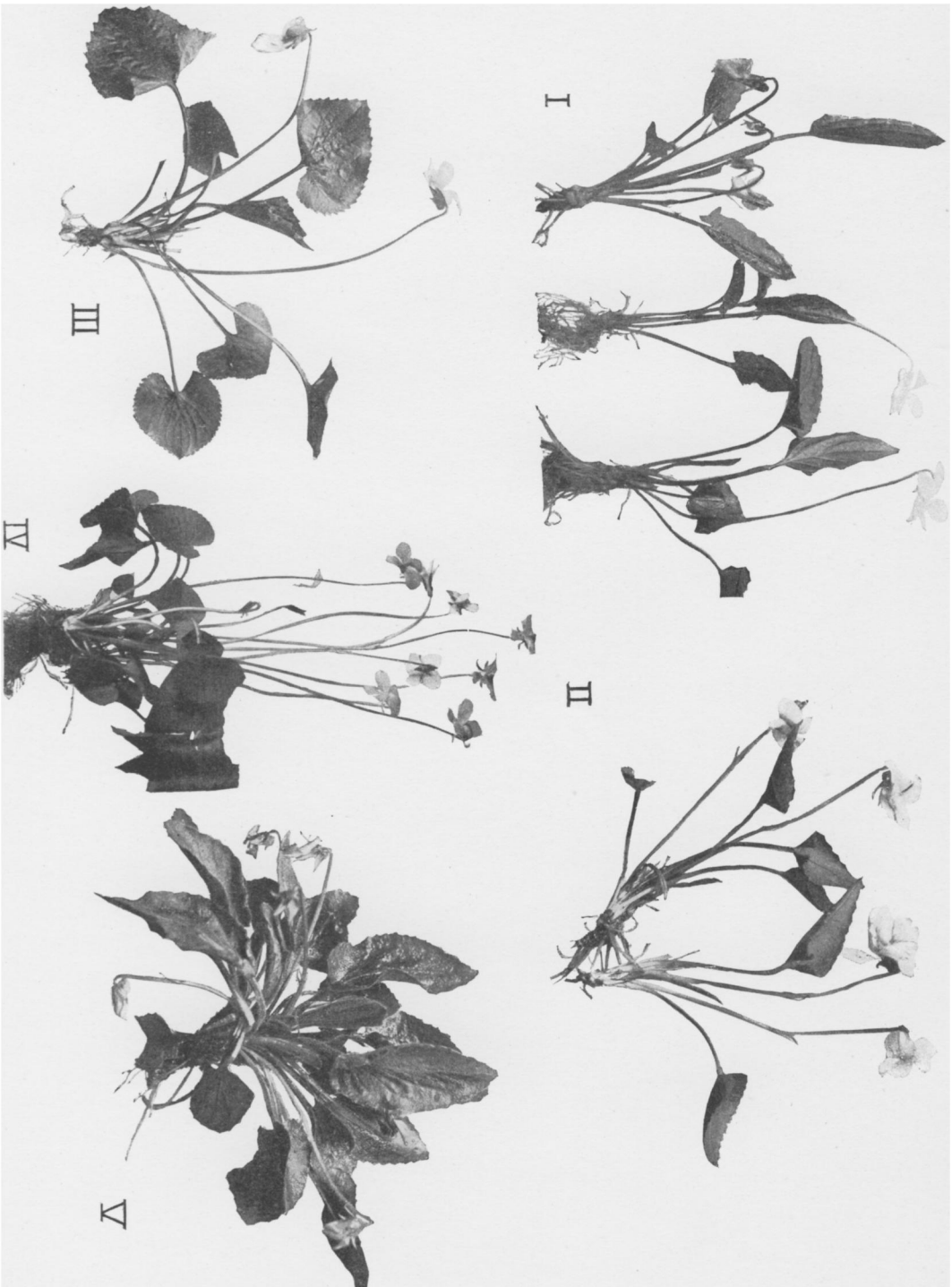
STONE. VARIATION IN VIOLETS.



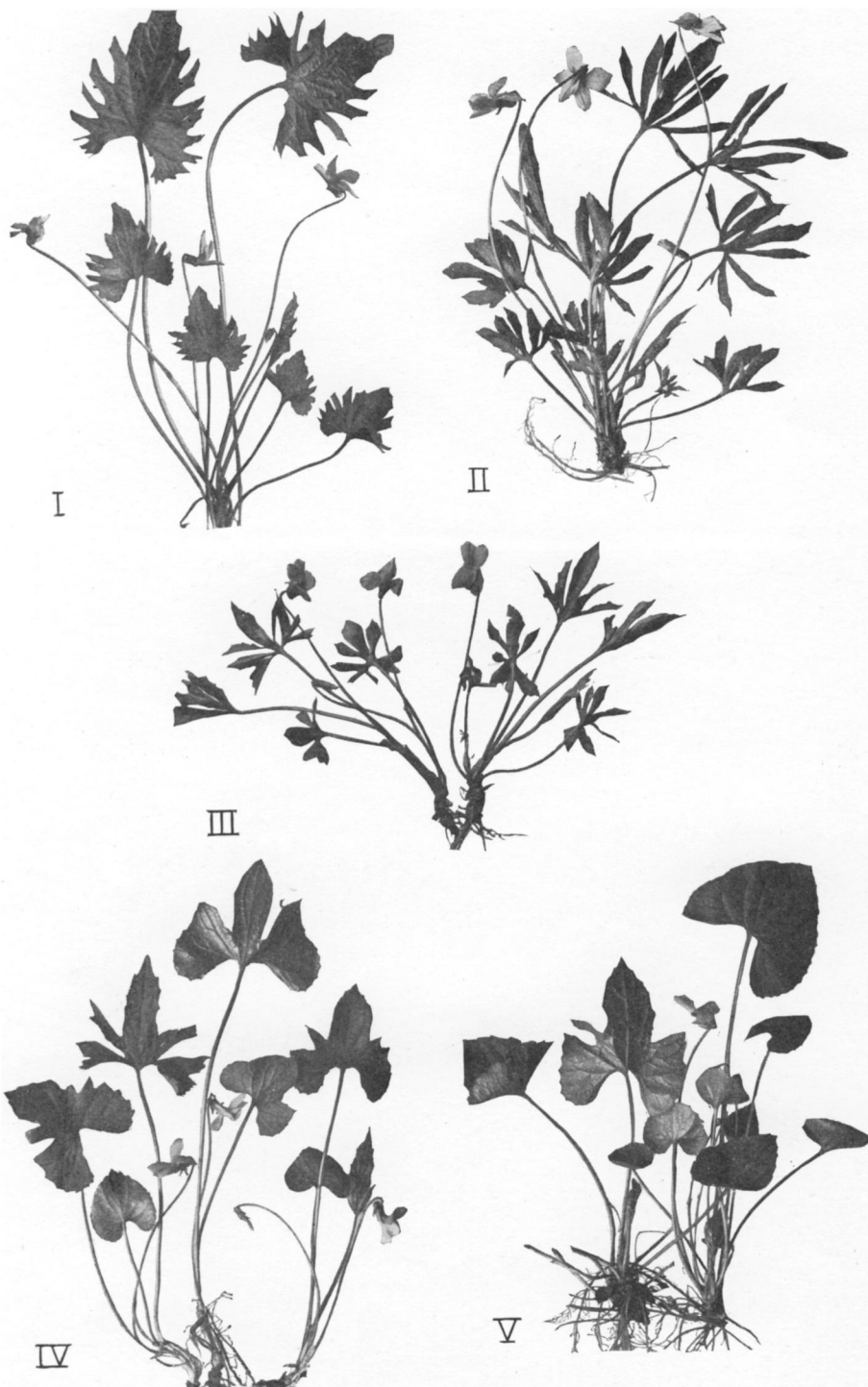
STONE. VARIATION IN VIOLETS.



STONE. VARIATION IN VIOLETS.



STONE. VARIATION IN VIOLETS.



STONE. VARIATION IN VIOLETS.